1954

Annual Report

Northeastern Forest Experiment Station

Upper Darby, Pennsylvania
Ralph W. Marquis, Director

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INTRODUCTION

Once a year, as we prepare our report on research results and formulate our program for the coming year, an opportunity comes to look beyond our own activities and observe the changes taking place in the region as they are related to forestry. Bits of information come in from our fieldmen, from members of the Northeastern Forest Research Advisory Council, from trade journals and other publications, and from other sources. These are pieced together, not to present a complete report on new developments, but to serve as straws in the wind--a sample of happenings--to show the direction in which forestry is moving.

This review is rewarding. From it we learn where knowledge gained from research is being put to use. But the greatest value comes in learning where research is needed and in what fields it should be intensified. This knowledge helps give direction to the Station program within its limitations of personnel and finances, and indicates in what fields expansion of our program might be needed to serve the region adequately.

Forest Industries: A Look At The Future

There has been much interest in the report of the Stanford Research Institute, "America's Demand for Wood 1929-1975," released by the Weyerhaeuser Timber Company. A few highlights from this analysis: Lumber prices will rise more rapidly than prices of competing materials. Pulp prices will stay in line with prices of competing materials. Lumber production is expected to rise moderately by 1975, with all the increase in the West. The present level will hold in the East, and production will decline in the South. Pulpwood production for the Nation may double by 1975. Eastern pulpwood production is expected to be about 50 percent above 1952, but only if there is a decided shift to hardwoods. Mill residuals will make up a much larger part of chippable material. Production of fuelwood is expected to decline sharply. Total log and bolt requirements, in cubic feet, will be lower in the Eastern region in 1975 than in 1952.

The Forest Industries Today

The past year was perhaps not as kind to the forest industries of the Northeast as 1953 was, but all in all it was another good year. Though one paper mill in New York went into bankruptcy and suspended operations, the pulp and paper industry was generally prosperous and markets were active. Lumber production in 1954 is estimated to have been below the 1953 level--possibly 15 to 25%--due to slow markets early in the year and log shortages resulting from excessive rain in the northern part of the region. The woodturning, specialty, pallet, and furniture producers are reported to have maintained production; but there was a reduced production of railway ties and mine timbers and props. Plywood markets suffered from foreign competition, but a pick-up was reported for the third quarter. The textile-wood industry has probably been hit the hardest; several plants have closed, and others have converted to other products.

Several significant changes in ownership took place during the year. The Brown Company disposed of the Brown Corporation holdings in Canada, and this is expected to result in their making greater use of New England wood supplies. The Hollingsworth and Whitney Company was merged with the Scott Paper Company, this giving the latter more pulp-producing capacity in the region. The Groveton Paper Company took over the Diamond Match Company mill at Platts-

burg, N. Y. Other companies are reported to have added to their timberland holdings.

Many of the large Adirondack estates, passing by inheritance, are being sold by the heirs to wood-using industries. Not heavily cut for hardwoods in the past, these lands are providing a new source of raw material. In New Hampshire a considerable interest in acquiring timber lands for investment is reported, despite the uncertainty of the property-tax situation.

The expansion of plants and the installation of new equipment give evidence of the confidence the wood-using industries have in the future of the Northeast and of the progressiveness of management. If the industry was ever bound by tradition in its woods and plant technology this is no longer true. Probably the outstanding development of the year has been the expansion of the Great Northern Paper Company pulp and paper plants in Maine, at a cost reported to be close to 50 million dollars. The production of chemi-groundwood pulp will create a new demand for hardwood pulpwood that may reach 100,000 cords a year. Certainly this development will have a far-reaching effect on land-management programs in the area.

There is growing interest in debarking wood and chipping it for pulpwood use. In December the Champion-International Paper Company dedicated its hardwood debarking plant at Bow, New Hampshire. Pulpwood is brought in long lengths to this yard, debarked, slashed, and transported by rack cars to their pulp mills at Lawrence, Mass. Slab debarkers are on the way, and slab chippers are in use, as is equipment to separate bark from chipped material. Portable barkers and chippers may not be far away.

In the woods the use of power saws is increasing so rapidly the crosscut saw is becoming a museum piece; tractors continue to replace horses; and many types of small and large wood loaders are being used. At the sawmills there are more planers, cut-up machinery, and small sash-gang saws for log-grade timber. A plant to make hardwood flooring by a radically new process has been built in New Hampshire. Massachusetts has a new veneer mill. New wood-preserving plants have been installed and there is a greater interest by the large established plants in doing custom business. All these developments point to progress in making better and fuller use of wood supplies.

There is a reported easing in the woods labor-supply situation, and unemployment among loggers is reported in

some sections. But in others the problem is still acute. Representatives of the pulp industry are interested in a plan to establish forestry camps for young men to interest them in woods work as a vocation.

Interest in roads is increasing. In part this results from the serious erosion that resulted on poorly laid out roads following the heavy rains of the past year. But there is a recognition of the fact that skid roads, truck roads, and highway transportation are a tool in forest management and utilization that merits more attention. It is reported from Massachusetts that with better transportation facilities there is an increase in the number of stationary sawmills. Normally this means better manufacturing and utilization. In Maine, river driving is being given up by some companies because truck hauling is becoming an increasingly efficient means of transporting pulpwood. We need to know much more about logging roads: the relation of layout, pitch, curvature, surface, and other factors to construction and maintenance costs, trucking efficiency and costs, and cost of skidding to the truck road.

The problems and opportunities are pointed up in Maine, where formerly inaccessible areas are being opened up by new access roads. Effects of this development on forest-management practices are already evident. New cutting priorities are being established that provide for the harvesting of large blocks of overmature timber in the near future, while young but operable stands are being by-passed and left to add valuable growth. This results in the harvest of vast amounts of timber in the mature stands that would otherwise be lost to insects, disease, or decadence; and this may well place these stands in a better condition to resist future attacks. Access roads permit shorter cutting cycles and more intensive forest management, better fire control, and better means of salvage following fire, blowdown, or mortality from forest pests.

Active Interest In Hardwoods

There is evidence of a marked increase in interest in hardwoods, and a growing local respect for many northern hardwood species that have always been esteemed by users in other regions. More New England sawmills are cutting hardwood. There is more interest in and knowledge of technical grading. This is a step toward better utilization and better returns for the mills. Though hardwood is abundant in the Northeast there is concern about future supplies of good

quality timber of the more valuable species. This concern is being translated into an active interest in hardwood management and in research programs seeking to find methods of providing a continuous supply.

The so-called low-quality problem, discussed in last year's Annual Report, is still with us, and will continue to be for many years. It is not a problem to be solved by one spectacular development, but by dozens or possibly hundreds of small steps that, taken together, may make up a spectacular accomplishment.

Steps to the solution were separated into three classes: an increase in the value of currently submarginal material, a reduction in the cost of harvesting and utilizing it, and an economic advantage in getting rid of it to release productive growing space. Encouraging progress has been made in all three approaches.

Increased pulping of hardwoods has been the most important factor in raising the value of this low-quality material. Between 1944 and 1952 the use of domestic hardwood for pulp in the region almost doubled, and in 1952 the region used about a fourth of the total hardwood pulpwood used in the United States. The trend to heavy hardwoods will probably continue. Chemical debarking, or chemi-peeling, is past the experimental stage and has become an accepted commercial process. This process adds to the efficiency of preparing pulpwood for market and serves as a useful tool in forest management. Marking trees for cutting in this way insures adherence to the cutting plan.

There is also a greater interest in charcoal production to meet the small-package recreational demand, some expansion of the chip market, and a greater interest in integrated use, which contains the possibility of utilizing trees that would be submarginal if use were limited to a single product.

Interest in getting rid of nonmerchantable trees as a forest-management measure is increasing as more effective and less costly means of killing them are discovered. These are discussed more fully in the Forest Management section. The use of poison in frills or single ax cuts spaced at about 4 inches costs less than girdling. Improved equipment and methods of applying the poison minimize danger to wildlife. Several large companies and many small owners are ridding their stands of undesirable species and trees through the use of these newly developed methods.

Weather Was An Important Item

The year 1953 was generally a dry one. 1954 was both dry and wet. New Jersey, Delaware, and eastern Maryland experienced a serious drought during late spring and early summer, and fires and water were again problems. Decreased streamflow caused more brackish water in some of the streams supplying water for irrigation, and there was damage from salinity to irrigated orchards and crops. Records from the Dilldown watershed indicate that groundwater levels in the Pocono Mountains of Pennsylvania were the lowest in many years. Soil moisture became seriously depleted during June and July. In April, Mayor Wagner of New York City declared a water emergency and stated that the shortage was more serious than in 1949 and 1950.

Rain, floods, and erosion, however, were more in the minds of the people this year than drought and water shortages. The northern part of the region had record-breaking precipitation and severe individual storms. In Maine, for example, rainfall in 1954 exceeded normal by a third to a half, and one storm brought over 7 inches of rain in less than 24 hours. And at the other extremity of the region, West Virginia had two severe floods that caused millions of dollars of damage.

Surveys following these floods showed that where logging roads were properly located, constructed, and maintained, there was little loss or damage. But roads that were laid out without regard to watershed management were severely eroded, and added to the silt and pollution downstream. As a result there has been a greatly increased interest throughout the region in proper road location and design.

Interest in the relation of forest management and cutting practices to water yield continues. The Station, following the receipt of appropriated funds, has initiated a program of watershed-management research in the White Mountains of New Hampshire. There is pressure in New York State for legislation to initiate a basic study of timber cutting-water relationships. The Allegheny Section of the Society of American Foresters is devoting both its winter and summer meetings this year to the relation of forests and water. Following the enactment of Public Law 566 by the 83rd Congress there have been a large number of applications for federal aid from local conservation groups interested in action programs for watershed protection and flood prevention.

An unusual and interesting court suit is being brought in West Virginia in which the plaintiff, having suffered losses from high water, is seeking to recover damages from a lumber company which is alleged to have logged the watershed above the flooded area in a careless and improper manner.

Blowdown was again a matter of great concern to forest land owners, not so much because of the damage done, though it was severe in some places, but because three hurricanes--Carol, Edna, and Hazel--cut across the region in one year.

There was concern that the pattern of storm movement might be changing, perhaps permanently, and that the Northeast should prepare itself for more frequent blows. A review of the literature on hurricanes discloses nothing to support this apprehension. The best word to describe hurricane behavior is "freakish." The year 1914 had only two storms, both weak; by contrast, 1933 had 21. In 1933 five major tropical storms departed from the normal course and swept westward across the Gulf and into Mexico. In 1955 a hurricane developed in January, something not previously observed since the days of Columbus.

The causes of this erratic behavior apparently are not fully known. Storm paths appear to be governed by air movements in the upper atmosphere, where there is a band with very long wave motion--only three to five crests and troughs--circling the globe. The position of these crests and troughs is believed to determine storm paths. The forecasting of hurricane behavior is improving rapidly. The path of a going storm can now be predicted with considerable accuracy 24 hours in advance, and with the use of electronic computers it is hoped that accurate predictions can be extended much further. But there are still mysteries of high-level air circulation to be solved.

Of greatest significance is the realization that the region can expect strong winds following an erratic pattern in the future, as in the past. Knowing this, it can be prepared for efficient salvage operations after a blow comes, and it can do whatever is possible through cutting and management practices to minimize blowdown losses.

"It's an ill wind....." The winds of 1954 provided the first good test of the relation of recently introduced management practices to wind damage, gave some new indications of what species should be considered windfirm, pointed to the need of more information on the length of time blown-

down timber of different species in different areas will remain salvageable, and gave some evidence that blown-down timber in selectively cut stands brings higher stumpage prices than salvaged logs from untreated stands.

Those who have been advocating marking and cutting stands on the basis of tree-selection silviculture--and particularly those owners who have adopted such practices--have been in doubt as to how well the stand left after partial cutting would withstand the normal gusty fall winds, let alone those of hurricane force. A review of the damage has been gratifying to both advocates and practitioners of selective cutting. From the white pine region the report is that in most cases the wind damage was no greater in selectively marked stands than in stands where no cutting had taken place. And in the spruce-fir region of Maine a high proportion of partially cut stands came through the hurricane very well. Greatest damage was reported in stands cut heavily to a low diameter limit, and in stands where topography seemed to intensify wind velocity. Wind did not do the damage in managed stands that many had expected it to.

Fire, Insects, Disease, Honeysuckle, And Deer Took Their Toll

Over the region as a whole the weather throughout most of the year resulted in low fire hazard. There was, however, high hazard in West Virginia and southern New England in the spring, and in the Middle Atlantic States in June and July. But all states except Rhode Island, Connecticut, New Jersey, Delaware, and Maryland reported fewer fires and smaller areas burned than in 1953.

The experience in New Jersey gave new evidence that prescribed burning, in addition to being an effective silvicultural measure, is also an aid in checking the loss from wildfire. After some 25,000 acres were burned over in Burlington County, a few "islands of green" remained. Some of these were swamps; others were areas that previously had been treated with prescribed burns. Intense fires that had crowned on adjacent untreated areas quickly came down and died out when they struck the treated areas, on which most of the ground fuel had been removed.

An appreciable increase in damage occurred in balsam fir stands in northern New England as a result of balsam woolly aphid attack. A heavy outbreak of beech scale and Nectria was found in Vermont for the first time. A sawfly infestation in pine is building up in Maryland and New

Jersey. Although winter mortality and feeding by predators caused some reduction in population, the red pine Matsucoccus scale continues to kill trees at an alarming rate. Over a million acres of forest land in New York and the New England states were sprayed in May and June to combat an outbreak of gypsy moth. This, plus an epidemic of the "wilt" disease and a high incidence of parasitism, has greatly reduced the infestation. The spraying of 20,000 acres in Maine against the spruce budworm was highly successful. Aerial surveys showed a marked reduction in defoliation over the whole northern area, and egg-mass surveys indicate light defoliation for 1955 and no need of spraying. The forest tent caterpillar remained active, especially in New York and Vermont. Some 20,000 acres, mostly sugar maple orchards and recreational areas, were sprayed. But the general outbreak is apparently being brought under control by the parasitic Sarcophaga fly.

Oak wilt has not spread into areas previously uninfected, and suppression programs in diseased areas are apparently giving satisfactory control. White pine needle blight was widespread throughout the region, but caused little mortality. Anthracnose of sycamore and oaks, leaf scorch on maples, leaf blisters on oaks, and leaf rusts on a variety of tree species were unusually prevalent, but no permanent injury is expected. Birch dieback continues at a greatly reduced rate.

Canada is to be congratulated on the construction of another new forest biology laboratory for research and surveys on forest zoology and pathology, this one at Fredericton, New Brunswick. We lack complete facilities such as this.

Honeysuckle is becoming more widely recognized as a forest enemy. In Maryland it continues to be a problem in the coastal plain area, and it is invading the piedmont area. In some areas it is so dense as to practically prevent any reproduction, and it has wiped out some young stands. Consideration is being given to the use of goats as a control measure.

No one seems quite ready to invite the wrath of the hunters by categorically classing deer as a forest enemy. But there is a growing realization that in many areas certain methods of forest and game management are incompatible. A limited harvest of antlerless deer has been recommended to the Vermont legislature as a means of reducing damage to forest resources. Running counter to the usual complaints is the opinion expressed by two owners in the Adirondacks

that a large deer herd is beneficial in controlling hardwoods and encouraging the establishment and growth of red spruce. We have ample evidence that deer, rabbits, mice, and other herbivorous mammals can be a menace to research. On some of our experimental forests small regeneration plots serve only to feed the wildlife.

Everyone Can Get Educated

Facilities for basic and advanced forestry education, for refresher courses, and for special technical training in the Northeast are being expanded and improved. At Pennsylvania State University the Department of Forestry has been raised to the status of a School of Forestry. The Yale University School of Forestry, as the result of a generous grant, is adding nine new scientists to its forestry faculty and is planning for expanded research and training of graduate students in forest biology. At the State University of New York College of Forestry, ground has been broken for the new Hugh P. Baker wood products laboratory. The number of fellowships and scholarships offered by the schools, foundations, and by industry--principally for graduate work--is increasing every year.

The second conference on forest production was held by the Harvard Forest at Petersham, Mass. Other forest schools offered short courses and found them well attended. Among these were courses in grading hardwood lumber at Pennsylvania State University and the State University of New York. The latter also offered courses in kiln-drying, wood gluing, and quality control; and held a school for junior executives in the furniture industry. The Station and the Forest Products Laboratory cooperated with the State University of New York and the Vermont Forest Service in a series of clinics on small sawmill operation. Three grading schools were held by the Northeastern Lumber Manufacturers' Association. Several logging safety conferences were held, including those at York Harbor, Maine, and Old Forge, New York. A dynamite school, sponsored by the Northeastern Loggers Association, was held at Tupper Lake. Many other technical meetings were held by the kiln-drying associations, the Forest Products Research Society, the Northeastern Wood Utilization Council, and others. The Northeastern Forest Pest Committee, the Pennsylvania Forestry Association, the several sections and chapters of the Society of American Foresters, the Forest Soils Conference, the Northeastern Forest Tree Improvement Conference, the Association of State Foresters, the American Pulpwood Association, and other

organizations held educational meetings. There is no reason for anyone in the Northeast to remain ignorant of forestry matters if he has time to attend meetings.

Some Matters Of Legislation And Policy

The report of the Timber Tax Study Committee of New Hampshire recommends that the basic principle of the present law be retained but that the abatement for approved forest practices be discontinued and that reimbursement to towns be gradually reduced and eventually eliminated. A tax-study committee is also studying the timber-tax problems of Vermont. In New Hampshire efforts are being made to obtain legislation establishing a contingency fund for forest insect and disease control.

In New York there is growing concern over the high compensation rates in the logging industry. In the Adirondacks the average rate is reported to be 21 percent of logging payrolls, and some contractors are paying rates as high as 25 percent. This condition has focused attention on better safety practices in the woods and other possible means of reducing this charge.

Use Of Publicly Owned Lands

Multiple use of publicly owned lands is increasing. Municipal watersheds are slowly being opened up for thinnings and harvest cuttings, but with proper precautions to safeguard water quality. New Jersey is acquiring the 100,000-acre Wharton Estate, primarily as a water reserve, but with the hope it can be managed for multiple use. State forests in Pennsylvania will soon be supplying quantities of logs for local industries. Plans are being reviewed for the construction of a dam and lake on Coates Run in the Gauley District of the Monongahela National Forest. A cooperative project between the Forest Service and the West Virginia Department of Conservation and Development, this improvement is primarily to improve fishing and recreation.

Controversy over the use of New York State Forest Preserve Lands continues. There are proposals for the purchase of additional land. There is pressure for amendment of the constitution to permit management of the forest preserve for timber production. And there are strong protests against any change in the "forever wild" policy. The New

York State Legislative Committee has proposed some less controversial programs, including the improvement of roads through the Park lands and the sale of small parcels of land outside the Park boundaries, with funds resulting from such sale to be used in purchasing lands within the Park. There has also been a proposal to set aside areas of publicly owned timber within the Park--perhaps 50,000 acres in all--for study and demonstration.

More Forestry Being Practiced On Private Lands

There is encouraging progress being made on the larger industrial forest holdings in taking control over timber cut from the hands of the operators and placing it in the hands of company foresters. Without attempting to appraise such progress for the entire region, examples taken from states at the two extremities of the region can illustrate the trend.

In West Virginia industrial forestry has made most progress in the southern part of the state, following the employment of foresters by a few of the coal companies. The most successful of these foresters have been the ones who were able to control logging on company land through supervision of road layout, size of trees cut, and stand improvement. During the past year the Union Carbide Company added its 40,000 acres to the area of private land under management.

In Maine, at the other pole of the region, there has been considerable interest among industrial owners in giving control over cutting to company foresters. During the past year all the timber cut on lands of the Penobscot Chemical Fibre Company was marked first. Among the non-industrial owners the Dead River Company has taken similar action, but most of the large non-industrial holdings--owned by land companies, banks, estates, and a few individuals--have been operated for highest immediate returns for each acre cut. And the operators controlled the cutting. In recent years agents and managers of these holdings have realized this was a short-sighted policy, and some of them have made real efforts to introduce more conservative cutting to maintain reasonable productivity. During the past year the outlines of a more positive management policy for some of the large holdings have begun to take form. A large tract in northern Maine has been marked by a consulting forestry firm for selective cutting on a 20-year cycle. The extension of the road system, mentioned above, has permitted others to give top priority to early operations in overmature stands.

Tests of the practicability of the Station's proposed new method of forest-management planning, using control techniques developed by Hough, are planned in Pennsylvania and New Jersey.

The introduction of better practices on small holdings is not as spectacular as when applied to large ownerships, but it is more important, for more than three-fourths of the privately owned commercial forest land in the Northeast is in holdings of 5,000 acres or less. Progress in getting better forestry on these small holdings is slow. Best results have come through personal contacts and demonstrations, but the staffs of service foresters in the state organizations are not large enough to provide more than a small part of the help needed. Nevertheless there is progress, and the organization of activity for assistance is improving.

In Maryland a revolving fund, maintained by contributions from benefited landowners and reimbursements from PMA, supports two crews of men with equipment to improve small holdings. In New Jersey temporary crews recommended by State foresters have been employed directly by private owners, mostly on prescribed burning. Much of the recent increase in stand improvement by small owners in Massachusetts is credited to incentive payments through the Agricultural Conservation Program. This program has apparently also been important in stimulating similar progress in New Hampshire and other states. Much of the work in New Hampshire is being done under contract by consulting foresters. A considerable amount of aid in forest management and in harvesting methods is being given small owners and operators by the industrial companies which purchase their products. The pulp companies have taken the lead in providing this form of assistance.

There has always been a general willingness among owners interested in forestry to conduct stand-improvement operations if the sale value of the products taken out met or exceeded the costs of removing them. A development of some significance is the increased willingness of both small and large owners to invest capital in girdling and poisoning with no prospect of immediate return. The willingness to invest in future productivity is not limited to the removal of culls and other submarginal trees, but extends to planting, thinning, weeding, seedbed preparation, and in some cases to pruning for quality production.

STATION AFFAIRS

There was an unusually large number of personnel changes during the past year. Herbert Storey left the Station to assume new duties as Chief of the Division of Watershed Management in the Washington office. John Curry, formerly in charge of the Adirondack Research Center, accepted a position as general manager of the Whitney Industries at Sabattis, N. Y. Val Carolin and James Bean, both in forest insect research, transferred to the Pacific Northwest and the Lake States Stations, respectively. Wendell Ellsbury, formerly with Forest Survey, transferred to the Jefferson National Forest.

Howard Lull came to the Station in August as Chief of the Division of Watershed Management. Other new members of the staff are Richard Sartz and Robert Pierce, assigned to watershed management work at the White Pine-Hardwood Research Center; William Gabriel, who joined the genetics staff at the Morris Arboretum; Arthur Eschner in watershed-management research at Kingston, Pa.; and Henry Gerhold, William Sopper, and Harold Waddell, who joined the staff in forest survey. Carl Stoltenberg, assistant professor at Duke University, was with the Station for the summer.

Several transfers have taken place within the Station. Dick Trimble left West Virginia to assume charge of the watershed management work in New Hampshire. Stan Filip moved from the Pocono Experimental Forest to the Bartlett. W. E. McQuilkin was transferred to Upper Darby as assistant chief of forest-management research. Bob Curtis graduated from survey activities and is now in forest-management research at the Adirondack Center.

It is the policy of the Station to encourage the younger technical men to return to school for advanced work. This year five Station employees are on educational leave working for advanced degrees at Maryland, Yale, Cornell, Michigan, and Penn State University.

The various moves resulting from the Departmental reorganization which brought forest-insect and forest-disease research into the Forest Service have been completed. Field headquarters for these two divisions have been consolidated in the Forest Insect and Disease Laboratory, 335 Prospect St., New Haven, Connecticut. Philip Dowden is in charge of

the work of the Laboratory. R. C. Brown and J. R. Hansbrough have moved to Upper Darby to assume their duties as division chiefs in the fields of forest-insect research and forest-disease research respectively.

In the interests of economy and a more closely integrated program of watershed and forest management research, the Delaware Basin and the Anthracite Research Centers were combined to form the new Kingston Research Center, with headquarters at Kingston, Pa. The Delaware-Lehigh and the Pocono Experimental Forest are assigned to this center under the leadership of Milford Howard.

Research carries with it a duty to publish results, and the Station continues to disseminate its research findings through articles published in a variety of professional and trade journals and magazines, as well as through progress reports that were processed in our own printing plant.

During the year, more than 100 articles by staff members and cooperators were published. This is a big jump over previous years' publications (last year 73 articles were published). Part of the jump was no doubt due to the work of the forest insect and disease people who joined the Station in the reorganization.

An annotated list of these publications will be found at the end of this report. Some of these publications represent 15 to 20 years of study; others are little "potboilers", some representing the work of only a week or so. But taken all together, the length and diversity of the list indicates real progress and worthwhile contributions to forestry knowledge for our region.

FOREST MANAGEMENT

GENERAL

Last year our Annual Report described the conditions, problems, and progress in the various subregions of our territory being served by our several Research Centers. This

year we again report on progress by lines of work for the Station's territory as a whole. It is hoped that last year's discussion of subregional problems and programs will make it clear that what appear to be unrelated bits of progress are really parts of a unified regional approach to subregional problems.

Setback Due To Hurricane Damage

The forest-management program suffered some setbacks during the year. The biggest of these was the damage done to several of our experimental forests by the three hurricanes, Carol, Edna, and Hazel. The part of the Massabesic Experimental Forest that was burned over in 1947 was hit hard by Carol, and some damage was done to the unburned portion of the forest. About three-quarters of a million feet, principally white pine, was blown down and is being salvaged.

Hurricane Edna hit the Penobscot Experimental Forest and put down about 750 cords, mostly fir. Hurricane Hazel cut a number of swaths through the Pocono Experimental Forest and on several compartments damaged the growing stocks so severely as to destroy their usefulness for the treatments assigned.

Hazel also brushed over the Paul Smith Experimental Forest, damaging some of the experimental growing stocks, although not as severely as on the Pocono. On the Beltsville Experimental Forest, Hazel took down a number of seed trees on methods-of-cutting compartments, particularly in uncut strips. Details of how the damage on the several forests may force us to change our program or details of treatment have not yet been worked out.

Plans To Rehabilitate Massabesic Forest

A plan for rehabilitating the Massabesic Experimental Forest was prepared during the year. Most of the forest was burned over in the disastrous fire of 1947, and since then the burned area has suffered severe damage in the gale of November 1950 and again from Hurricane Carol in 1954. In between catastrophies, pales weevil associated with salvage cutting has precluded planting. The weevil population may build up again after cutting the three-quarters of a million feet blown down in 1954, but action on some phases of the rehabilitation program can be delayed no longer.

Of the 3,025 acres burned, 990 acres have present or potential merchantable stands left after the fire and storms. Nonproductive land accounts for another 580 acres. There are 1,125 acres with varying amounts of desirable reproduction where more or less planting and release are needed. Some 330 acres of potentially productive land lacks desirable reproduction and must be planted. Much of this area will require site preparation.

Part of the rehabilitation work will be financed from deposits for sale-area betterment made under the Knutson-Vandenberg Act when salvage cuttings were made. Regular research funds, national forest protection and management funds, and cooperative funds will be drawn upon for the rest of the job. For fiscal year 1955 an allotment of $3,000 of regular planting funds was made to begin the program. Studies looking toward mechanization of the release and planting-site preparation work are reported elsewhere.

Study of Compartment Inventory Methods

In an effort to still further improve the balance of our forest-management-research program, as between basic and applied research, a study of compartment inventory and sampling procedure was conducted. The compartment studies are large-scale experiments to test a number of forest-management programs. They constitute an important step in the progression from small plot studies to actual application of research results on operating properties. Heretofore the inventories on which growth, yield, and quality data are based consisted of measuring and tallying all trees 5 inches in diameter and larger on each compartment. This is an expensive and time-consuming job, for the compartments are 20 to 100 acres in size. Moreover, the reliability of such inventories had been questioned because of expected errors of omission and duplication in tallying.

The study was undertaken to determine the magnitude of the errors of enumeration in 100-percent inventories, and to seek a sampling procedure that would provide adequate data at material savings in effort. Two areas of 25 to 30 acres were completely inventoried three times, twice by one crew and once by another. The data from these inventories showed an average difference of 0.25 percent for one area and 0.63 percent for the other. Thus, if reasonable care is taken, the net effect of errors of omission and duplication is trivial in complete inventories such as these.

Evidence on possible savings of time through sampling was not conclusive, being necessarily indirect. Several alternatives were compared, using data from the study and other sources on stand variance, and time data from the study crew. It appears that as much as 50 percent of field time might be saved by estimating yield from measurements of change on a series of random plots on each compartment. Although such a system would increase computational time somewhat, we have no estimate of the amount. Further tests of the tentative sampling procedure to be made in 1955 will give a sound estimate of the net savings.

Some Other Developments

Another example of the continuing review being given the Station's program of forest-management research is the current re-examination of the problems and state of our knowledge of white pine. An important part of that review has been the compilation and annotation of a comprehensive bibliography on the silvics, silviculture, and management of the species, with selected references in related fields such as entomology and pathology. The program of management and silvicultural research that will evolve out of the review will be correlated with programs in genetics and forest-insect and forest-disease research resulting from similar reviews in those fields. The Station will thus have a unified and concerted approach to the problems of growing and managing this important species.

Similarly the Station is re-examining the forest problems of the area served by the Kingston, Pa., center with a view of reorienting its research program. In addition to research in forest and watershed management there appears to be a distinct need for studies in forest economics. Some change of emphasis in the forest-management and silvicultural studies seems also to be in order, probably in the direction of more attention to basic relationships such as the factors controlling regeneration, growth responses of controlled growing stocks, site quality factors, and wildlife-forest management interactions.

HARVEST CUTTINGS

Cuttings were continued about as scheduled on most of the large-scale experiments that have come to be known as the "compartment experiments" on seven experimental forests. Operations were slowed down on one forest by the change from

cutting by Station personnel to cutting by the purchaser of stumpage. On another where contract cutting has been the rule, the contractor had to postpone cutting on the experimental forest because of commitments elsewhere. On the other five experimental forests, however, the cuttings were on schedule. The total cut amounted to about 3/4 million feet a year. Cutting treatments on the various compartments and forests ranged from very light improvement cuts to clear-cuttings for even-aged regeneration.

Some Experiences From Cutting Operations

Harvest cuttings were continued on the farm woods studies and, as in previous years, showed that light improvement cuts on short cutting cycles can yield enough income to pay at least reasonable wages to the owner, while improving the growing stock.

On experimental forests where comparisons can be made, striking differences in income are being obtained between woodlots that started with a good growing stock and those that started with poor growing stock. On the Fernow Experimental Forest this difference in cash income amounted to $300 in the first 4 years of operation. Some of the farm woods or woodlot studies are now approaching their fifth year, at which time growing stocks will be reinventoried. Changes in quantity and quality of growing stocks can then be checked against yields from the annual cuttings to present a more complete picture of the effectiveness of the management being practiced.

The hurricanes of 1954 give added interest to the results of studies of wind damage in selectively cut stands of spruce and fir. During an average period of 3½ years after cutting on five areas in Maine and Northern New Hampshire, losses were 0.12 cord of merchantable spruce and fir per acre per year. Wind damage increased sharply when more than 20 percent of the total basal area of all species was cut. More than 60 percent of the damage to fir was breakage, whereas two-thirds of the damage to spruce was by uprooting. Large firs were specially vulnerable, as were dominant spruces that extended well above the general crown canopy. Size of opening and area cleared for sled and haul roads and landings affected wind losses too. But if more than 75 percent of the total basal area is retained in growing stock and a few other precautions are taken, it appears that losses can be reduced to 0.05 cord per acre per year. This is considered negligible compared to the growth possible

under good silviculture and management. These results are confirmed by two other areas cut 6 years ago. On those areas losses averaged only 0.06 cord per acre per year despite the 1954 hurricanes.

On the Penobscot Experimental Forest losses in hurricane Edna were heaviest on compartments commercially clear-cut and on those cut to low diameter limits. There an average of 0.37 cord per acre was broken or uprooted. On compartments where a good growing stock was maintained by light cutting, only 0.18 cord per acre blew down. This was less than the 0.25 cord per acre lost in uncut portions of the forest where poor risk trees had not yet been removed. Balsam fir made up 70 percent of the trees and half the volume blown down.

Experience and measurements on one compartment of the Penobscot Experimental Forest indicate that commercial clear-cutting of spruce-fir stands for pulpwood takes a considerable portion of the area out of forest production for some time. On this compartment the wood was cut into 4-foot lengths, piled at the stumps, and sledded to landings. Sled roads were about 50 feet apart. About 20 percent of the area was occupied by sled roads, truck roads, and wood yards. Heavy slash from the clear-cutting covered 34 percent of the area. Under the slash and on much of the road and yard area, reproduction will be delayed for an undetermined but appreciable period of years. It seems obvious that loss of production on half the area of a forest could seriously handicap management and might well make the difference between success and failure of efforts to grow timber as a crop.

Importance Of Good Growing Stock

Guides to the sort of growing stocks to maintain after cutting in Allegheny hardwoods-hemlock stands were obtained from tenth-year data on 4 plots of 20 acres each in a sawtimber stand. The growing stocks on three plots were reduced to approximately 2, 4, and 6 thousand board feet per acre. The fourth plot was uncut and had a growing stock of slightly more than 6 thousand feet per acre. Growth in board feet was greatest on the plot cut to 6,000 feet; it was 284 board feet per acre per year. The plot with 4 thousand feet grew at the rate of 219 board feet and the one with 2 thousand feet at 232 board feet per acre per year. The check plot increased by only 190 board feet per year per acre, largely because of the death of poor-risk trees during the 10-year period.

In cubic-foot growth, however, the plot with the lowest growing stock (1,300 cubic feet per acre) has the largest net increase, followed by the medium and heavier growing stock plots (1,600 and 1,900 cubic feet per acre respectively). Ingrowth of trees into the subsawlog size classes (12 inches and less) largely accounts for this reversal of order as between board-foot and cubic-foot growth. Growths per acre per year in cubic feet ranged from 45 on the check plot to 50 on the plot cut lightest, 51 on the intermediate, and 56 on the most heavily cut plot.

Regression analysis of data from a series of 1/5-acre samples taken on the plots showed 10-year basal-area growth of survivors was positively correlated with beginning basal area. And for trees 9.6 inches d.b.h. and larger, 10-year ingrowth was inversely correlated with beginning basal area. Other analyses of the data from the plots emphasize the importance of maintaining good diameter distributions in growing stocks. Trees in the 16- to 20-inch size made best growth on these plots.

The better yield from a larger growing stock is also evidenced by 10-year results from two other areas of old-growth Allegheny hardwoods on the Kane Experimental Forest. The growing stock on one had been reduced to about 6 thousand board feet per acre in trees 12 to 32 inches d.b.h. Its 10-year growth averaged 111 board feet per acre per year. The other area had a growing stock of 9.5 thousand feet per acre after cutting (in trees 12 inches d.b.h. and larger) and grew at the rate of 175 board feet per acre per year in the following 10 years. The areas are about 35 acres in size and are similar in site quality.

Another study of growth responses of Allegheny hardwoods involved plots cut to different diameter limits in a 43-year-old second-growth stand. The plots were cut to 11-, 8-, and 5-inch limits, which retained 962, 439, and 72 cubic feet per acre respectively for growing stocks. During the 10 years after cutting, total growth on the plots was 69, 63, and 46 cubic feet per acre per year for the high, medium, and low growing stocks, including all trees 5 inches d.b.h. and larger. At these rates 16 years would be required to replace the volume removed in the 11-inch diameter limit cutting, 26 years for the 8-inch cutting, and 34 years for the area cut to 5 inches. Ingrowth of trees into the 5-inch size accounted for nearly all the growth on the most heavily cut plot. Growth in operable trees (8 inches d.b.h. and larger) had a much wider spread among the plots than did total cubic-foot growth. The area cut to 5 inches grew only 120 cubic feet of such material in 10 years, the one cut to 8 inches grew 350 cubic feet, and the area cut to 11 inches

grew 500 cubic feet of operable wood during that time. It is obvious that the heavier growing stocks would support shorter cutting cycles and produce a given quantity of operable wood on considerably less area than the lighter ones.

Silviculture Of White Birch

White birch has, in the past, been an abundant and valuable species in the Northeast and has supported an extensive turning industry. But the fine stands on which the industry was based were due to fires and other catastrophies of the past that favored regeneration of the species. With improved fire protection and a slacking off in the rate of agricultural land abandonment, few new stands of white birch are starting; and current methods of cutting are not resulting in regeneration of the stands being logged. In many instances understories of more tolerant species are taking over areas from which the birch has been cut.

In an effort to develop a practical silviculture for white birch, a study was begun on the Hopkins Experimental Forest this year. It embodies the accepted principle that white birch seed germinates best on mineral soil and requires full sunlight for satisfactory growth. The experiment will test clear-cutting in strips, combined with scarification of the soil with a harrow, as contrasted with no treatment. The clear-cutting is complete and slash has been bunched with a bulldozer. Seed traps have been installed to measure seedfall from the chain-wide uncut strips. Information on quantities of seed, germination, early survival, and juvenile growth will become available in the next year or two.

Some Refinements In Use Of Chemicals

There is a great deal of interest throughout the Northeast in increasing the use of hardwoods, particularly in smaller sizes and poorer qualities. One example of this is the trend toward greater use of hardwoods for pulp. For this purpose, most companies prefer to have the wood peeled. But peeling seasons are short and the hardwoods are not especially easy to peel; so it has become widespread practice to use sodium arsenite to loosen the bark by killing trees quickly during the peeling season. The bark is then removed later, in effect prolonging the peeling season.

Some small refinements and improvements were made in the technique of applying sodium arsenite to trees, to debark them for pulpwood or simply to kill them for stand improvement. For debarking purposes the Adirondack Research Center found that applying the arsenite in a frill cut lightly into the sapwood was as effective as the standard commercial practice of painting the solution on a wide bark girdle that does not extend into the sapwood. The light frills are more easily made than the bark girdles and the solution can be placed in the frill with a battery-filling syringe. This saves some solution, but the increase in safety is more important. The solution is carried through the woods in a narrow-mounted glass jug instead of a pail or back tank as is necessary when brushes are used to apply the solution to bark girdles. Spillage and drip are almost eliminated by the new method and the use of the syringe eliminates spray and splatter so common when brushes are used. Since the arsenite is poisonous to animals, the reduction in amount of spillage cuts down danger to wildlife as well as to men working with the chemicals.

It often happens that the best time to control growing stock is when a harvest cut is made, by deadening unwanted or unmerchantable elements of the stand during or immediately after logging. If sodium arsenite is used to debark trees for pulpwood, other trees to be removed from the stand can be killed by the same methods at the same time. The Adirondack Research Center has found that when stand-improvement work is done as a separate operation, however, the arsenite is effective when applied in hacks spaced 2 to 4 inches apart. This is cheaper and faster than the frill method but is not so effective for debarking. Arsenite in hacks can be used effectively outside the peeling season. Actual cost figures on the new method have not yet been obtained but are expected to be less than $0.20 per square foot of basal area, which was the average cost for applying arsenite in frills.

STAND-IMPROVEMENT MEASURES

Studies Of Tree Deadening

Separate studies during the past 3 years in Maryland, New Jersey, and northeastern Pennsylvania show that, of the commonly-used techniques for deadening hardwood trees, a solution of 2,4,5-T in oil applied in an ax frill is the best all-round treatment, considering costs, convenience of application, and results. The studies also agree in showing

that ammate crystals applied in ax notches generally are effective as a summer treatment, but do not work well in late fall or winter applications, are more costly than the 2,4,5-T frill method, and call for more skill with an ax. Methods involving arsenic were not included in these studies.

Impetus for these studies came in part from indications that findings of southern investigators did not hold in the North, specifically the southern recommendation of a water emulsion of 2,4,5-T in frill treatments, and assurance that the ammate-notch method could be used successfully at any time of year.

In the Maryland study, involving red maple, various oaks, sweetgum and blackgum, January application of ammate in notches killed only about 30 percent of the treated stems. In Pennsylvania, in a test comparing July, September, and November treatments of red maple and beech, the results 2 years later were: July treatment--23 trees dead of 24 treated; September--23 dead, 1 dying of 24 treated; November--9 dead, 1 dying of 25 treated.

In the Maryland study, 2,4,5-T in oil at 8 pounds acid equivalent per hundred gallons, applied in frills, gave a kill of 86 percent the first year, with some additional mortality to be expected. The same concentration of 2,4,5-T in water resulted in only 28 percent kill. In Pennsylvania, 2,4,5-T in oil at the same concentration resulted in 86 percent of the trees dead or dying at the end of 2 years; with water emulsion the figure was 53 percent. Species in the Maryland test were red maple, oaks, and gums, treated in January; in Pennsylvania, they were red and sugar maples, yellow birch, and beech, treated in July. Though neither study included season as a variable among the 2,4,5-T treatments, together they constitute pretty good evidence that frill application of 2,4,5-T in oil is effective at any time of year.

Brush
Control

During 1953 and 1954, the Station has cooperated with Region 7 on five National Forests in the installation and evaluation of rather extensive tests of 2,4,5-T for control of brush along some 43 miles of forest roads, 15 miles of telephone lines, 3 acres of ski slopes, and 4 miles of foot trails. Treatment has been in part with water foliage sprays, and in part with oil basal sprays. Between 2,500 and 3,000 plants representing 29 species have been marked for future observations of kill.

Though only a few of the earliest applications have been checked for kills, one important fact other than species differences is emerging as regards water foliage treatment with 2,4,5-T: that the amount of root kill achieved is strongly correlated inversely with the size and vigor of hardwood sprouts.

For instance, on a roadside mowed the preceding fall and treated in May when the sprouts were small and succulent, and with the roots presumably somewhat depleted by the drain of new sprout development, root kills were good, even for such resistant species as red maple. Also, on a ski slope, with a past history of annual mowing, including mowing the preceding summer, foliage treatment in July of the relatively low-vigor sprouts resulted in better than 80 percent root kill. On the other hand, the kill was very poor on a roadside in its second year after mowing, when vigorous sprouts 2 to 4 feet tall were sprayed in July.

Species differences as observed thus far conform in general with results of our earlier tests and with the published findings of other workers; those differences will not be discussed further here. Likewise the general trend of differences between water foliage sprays and oil basal spraying is according to expectations, but cannot be adequately discussed until our observations are completed.

Research by others, with oil basal spraying, later fully confirmed by us in a repetition of the experiment, has demonstrated the importance of thoroughly wetting the root-collar area with the silvicide.

In our experiment, 15 old scrub oak root crowns were exposed by scraping away all litter and the surface inch or two of soil; then they were thoroughly wetted with 2,4,5-T in oil, in July. Another set of 15 plants was basally sprayed in the conventional manner, wetting the stems to the point of run-down, but without thorough soaking of the root collar. One year later, all 15 of the plants with root crowns exposed were unquestionably dead; of the 15 given conventional treatment, every one still exhibited some evidences of life, either by retention of some foliage, or by generation of new sprouts, or at least by persistence of green cambium on some stems. The practical implications of this experiment in routine work are that particular attention must be directed to wetting the root crown and root collar areas of sprout clumps, and that heavy accumulations of litter make it doubly difficult to do an effective job of basal spraying.

On one of the telephone lines treated in our cooperative work with Region 7, striking evidence of the significance of litter was observed in the fall after an early spring basal treatment. Most of the line was relatively free of litter and here top kills were good with little resprouting. But in certain sectors litter had accumulated and here there was almost 100 percent resprouting of the treated plants.

One of the purposes of these cooperative studies is to get data on costs of chemical brush control as compared to annual mowing. Since a chemical treatment invariably will cost more than one mowing, chemical control can result in savings only if a treatment is good for several years. Our information on the interval allowable between chemical treatments is just beginning to accumulate; present expectations are that the practical interval will be about 3 to 5 years.

Annual mowing costs for roads run around $15 per mile. Our costs for chemical treatment have varied considerably with different densities of brush and different crews; and because of lack of experience, the costs probably are higher than would be true under well-organized administrative operations. Present indications are that water foliage spraying can be done for about twice the cost for mowing, and that oil basal treating can be done for 3 to 4 times the cost for mowing. Also, when retreatment is required, the job is expected to be somewhat simpler and less costly than the first treatment.

Hence, the outlook at this point in the program is that a change-over to chemical control on roadsides will reduce roadside maintenance costs to a modest degree. It would be foolhardy to indulge in more than this conservative prediction until we have the benefit of several more years' observations.

REGENERATION

How to exert control or influence over seed production of a number of species begins to loom as a field needing research in the Northeast. Considerable is known about seedbed requirements for most of our important species, but years of abundant seed production are erratic and well-nigh unpredictable. On the Massabesic Experimental Forest, for example, there was a bumper crop of white pine seed in 1947, but not another one since then. The tremendous crop of hemlock seed on the Penobscot Experimental Forest in 1953 is described below. On the Beltsville Experimental Forest 1953

was a good year for Virginia pine seed, but in 1954 the crop was only a tenth as large and test germination has been far below that of the 1953 crop.

Seedbed preparation at best provides only transient conditions. Where a growing stock of larger trees is maintained, litter soon covers the seedbed, and where patches or larger areas are clear-cut grasses, briars, ferns, or brush commonly invade unless tree reproduction is abundantly and promptly established. These changes take place rapidly and a well-prepared seedbed may lose its effectiveness in as little as 1 or 2 years. Unless seed is available at the right time and in sufficient quantities, money spent on seedbed preparation will probably be wasted.

The search for effective ways to use seed crops should probably take a number of directions, depending on species. For some species we should learn how to select seed trees for fruitfulness, for others we may be able to devise some conditioning treatment; and for still others we may have to delay seedbed preparations until a seed year comes along--and learn how to recognize a year or two in advance when one is coming. Regeneration is presently so dependent on apparently haphazard seed crops that whatever we learn about controlling or predicting seed production will increase assurance of successful reproduction, without which forest management is foredoomed to failure.

The Penobscot Experimental Forest gave an example of how prolific Nature can be on occasion. Seed traps installed in connection with a study of seedbed preparation indicated an average of well over 13 million hemlock seed per acre in the fall of 1953. One trap caught seed at the rate of 23 million per acre. Sixty-nine percent of the hemlock seeds were sound. The average catch of birch seed was over $1\frac{1}{2}$ million per acre. In August quadrat samples indicated more than 4 million hemlock seedlings per acre on the most favorable seedbed (humus removed) and 852,000 per acre where there had been a light surface burn. Where humus and soil had been mixed there were nearly $2\frac{1}{2}$ million and on undisturbed litter a little over 1-1/3 million per acre. By November, however, 36 percent of the hemlock seedlings on the treated areas had died and 52 percent of those on the undisturbed litter. The summer was very wet, and damping-off is suspected of being responsible for the losses.

Interesting changes have taken place during the last 2 years on a series of plots established to test seedbed-preparation measures following a seed tree cutting in a loblolly pine-hardwood stand on the Eastern Shore of Maryland. The treatments used were: partial furrowing with a Ranger

Pal plow; summer burning; and summer burning and a stump dragged about to scarify soil.

In the first growing season after treatment the untreated check plot had 4,080 pines per acre stocking 78 percent of milacres; the plowed plot had 6,160 on 94 percent of the milacres; the burned only plots had 7,640 on 96 percent; and the burned and scarified plot had 9,400 per acre on 100 percent. In all plots the amount of pine reproduction has decreased since 1952, the decreases ranging from 140 to 1,500 per acre, with the biggest decreases on plots plowed or summer burned only. Even so, however, pine reproduction is still satisfactory, ranging from 68 percent of milacres stocked where no treatment was applied through 88 percent for plowing, 92 percent for summer burning, and 98 percent for summer burning and stump dragging.

Hardwood seedlings and sprout clumps are increasing in number on the treated plots but not on the untreated plots. The hardwoods are growing in height more rapidly where they were burned or knocked down than on the untreated plots. Recovery, or height growth, is fastest where the hardwoods were killed to the ground by fire.

Despite this fast recovery of the hardwoods, burning has permitted the pines to outgrow the hardwoods and exceed them in height on 24 percent of the quadrats that were summer-burned only. Where stump-dragging was used too, the percentage was increased to 44. Plowing helped pines attain dominance over hardwoods on only 12 percent of the quadrats. Where the hardwoods were not treated at all, the pines exceed hardwoods on a mere 4 percent of the quadrats.

SCRUB OAK CONVERSION STUDIES

The several planting studies begun in scrub oak areas during the period 1948-1953 remain under observation. In the last study begun, a planting of red pine and Japanese larch after site preparation with a tractor-mounted root rake on the Dilldown Forest, first-year survival was 86 percent for the pine and 81 percent for the larch. The root rake does the best job of any machine tried for mechanical preparation of stony scrub oak land. Practically all planted seedlings are sufficiently in the clear so that there will be no need for release from overtopping brush.

Though earlier plantings at Dilldown had been singularly free from deer damage, some 16 percent of the red pines in the root-rake planting in 1953 were damaged by deer during the first winter. Apparently our plantings and the

exclusion of fire from most of the area for the past 10 years are inducing a build-up in the local deer population.

The 1949 plantings in scrub oak off the Dilldown Forest in areas of greater deer pressure are showing that the larches and Norway spruce suffer little deer damage and that, of the pines, Scotch pine is browsed much less than pitch, red, jack, or white pines. White pine has been browsed most unmercifully in our plots.

In all the Dilldown plantings where sites were prepared with heavy equipment--bulldozed furrows, roto-tilled strips, root-raked strips--stands of acceptable density are developing without post-planting release treatments. Only in the bulldozed furrows is there any appreciable suppression of seedlings by overtopping brush; here the losses to suppression probably will be from 5 to 10 percent of the present survivors.

In the 1951 test to establish a skeleton pine stand of about 300 trees per acre by interplanting in the brush without site preparation, survival has been satisfactory and most seedlings have grown clear of the low competition, but their general vigor and growth rate are conspicuously poorer than where ground preparation has been done. The depressive factor apparently is root competition. Currently some small experiments are under way to explore the practicability of eliminating competitive vegetation from planting spots by use of silvicides.

SILVICS

Silvics is generally considered the fundamental base on which silviculture rests. It concerns the life history of trees and stands and their relation to environmental factors. Observations on these processes and relationships are usually picked up in the course of studies in other fields rather than from special studies. Additions to our knowledge of the silvics of important species therefore often appear fragmentary. During the past year a number of such bits of information have been picked up.

For example, a study of the formation, behavior, and persistence of dormant buds in shortleaf and pitch pines in New Jersey cast light on the sprouting of these species following injury by fire or other agents. It was found that the buds that are formed in needle fascicles persist and will develop into shoots for at least 13 months. Terminal buds of tip or branches are therefore readily replaceable. The buds that develop just above the cotyledons in pitch and

shortleaf persist and respond to stimulation by dividing or developing into shoots. The buds were found to persist in shortleaf pine up to 85 years old, and in pitch pine up to 81 years. Dormant buds along the bole and main branches form the basis for recovery of pitch and shortleaf pines from fires that kill, and sometimes even consume, the foliage. They are also the source of new branches that develop on seed trees left after cuttings.

Preliminary results in a study of factors determining site quality for red spruce indicate that there is no relation between depth of soil to hardpan or other impervious layer and site quality, or between depth of root penetration and site quality. This is somewhat at variance with general opinion, but seems to hold even for the better mixed-wood stands and sites.

Sprouting of hardwoods is a desirable characteristic under some circumstances, but more often is undesirable, as when it is desired to control them and to favor conifers. It is of interest therefore that sprouts developed on only 25 to 30 percent of trees killed with the sodium arsenite bark-girdling technique on the Beltsville Experimental Forest. The trees were mostly oaks.

WATERSHED MANAGEMENT

Interest In Water Problems Increases

The heightened interest in water and watersheds found in the Northeast has its counterpart in other regions and at the international level.

President Eisenhower has appointed the Secretaries of Agriculture, Defense, and Interior as a Water Resource Policy Committee to study possibilities of modernizing federal water-resources programs and to cooperate with the Hoover Commission. The President has also established an interagency committee on water resources to facilitate coordination of existing water policy.

The 83rd Congress passed a new watershed-protection and flood-prevention act based on a cooperative approach to upstream protection and flood prevention. The new law places the responsibility for initiating watershed-protection projects with local sponsors. Substantial local contribution to the cost of each project is required.

At the international level, the State Department's United Nations Economic Committee approved United Nation emphasis on problems of water-resource development. Three high-priority problems were approved for United Nations attention: collection of hydrological data, watershed management, and water for domestic, urban, and industrial users.

Late in the year a National Watershed Congress was held in Washington to consider national land and water policies, existing and needed federal and state legislation, federal inter-agency coordination, and organization of watershed associations.

Watershed Research In The White Mountains

Watershed-management research in New England got under way this year when, in a late appropriation bill, Congress approved funds for the establishment of watershed-management studies in the White Mountains of New Hampshire. The new project is under the White Pine-Hardwood Center, of which V. S. Jensen is research center leader.

Research on water problems is badly needed in this area. The White Mountains make up the headwaters of the Merrimack, Saco, and Androscoggin Rivers, and part of the Connecticut River. These are the main sources of New England's industrial and domestic water and hydro-electric power; and are also the main flood-producing rivers of the area. To date, our knowledge of watershed behavior on the glaciated soils and mountainous terrain of the White Mountains is meager indeed. The research now getting under way should, in time, give us this important information.

Research area and personnel selected.--Selecting the area for watershed-management studies began in the latter part of August. H. C. Storey and H. W. Lull, with the help of the late C. L. Graham, then Supervisor of the White Mountain National Forest, made the first go-around, and narrowed the field to about half a dozen possibilities. The final selection of Hubbard Brook watershed was made by Lull, Jensen, and Trimble. In the meantime personnel for the new project were being lined up. G. R. Trimble, of the Mountain

State Center, was chosen to head the project, and R. S. Sartz from the Washington office Photo Interpretation Project and R. S. Pierce from the Vicksburg Infiltration Project were recruited to assist him. Trimble, who has been detailed to the project off and on since the middle of August, came to stay on November 10. Sartz reported on October 10, and Pierce arrived early in January.

Hubbard Brook watershed.--Hubbard Brook flows into the Pemigewasset River from the west at West Thornton, a small community 13 miles north of Plymouth, New Hampshire. The research watershed, which is part of the White Mountain National Forest, covers about 7,500 acres. The main brook flows westerly and has enough permanent-flow tributaries draining both the north and south slopes to make it suitable for watershed studies.

The watershed is almost completely forested--mostly with northern hardwoods, spruce-hardwoods, and scattered patches of spruce and fir. The original stand was logged about 40 years ago, and there has been no cutting since then; so much of the timber on the area will be merchantable by the time experimental treatments are made. The soils are shallow and stony. They are strongly podsolized, derived from granite, and very erosive where the mineral soil has been exposed. Stream channels are bouldery, and the gradients are steep, factors which will make good stream-gaging sites hard to establish.

Preliminary work started.--A special airphoto project was flown on November 10 by Forest Service personnel and airplane from the Beltsville Forest Insect Laboratory. Contact prints at a scale of 1 to 7920, and 25 low-altitude obliques have been received. Photo mosaics will be forthcoming soon. These will not only be valuable working tools for type-mapping, delineating small watershed boundaries, laying out roads, and general orientation in the field; but also can be used for large-scale topographic mapping later.

Research results.--Apart from the Hubbard Brook Project, some study was done on the effect of hurricane-type storms on logged watersheds. Inspection of one of the hardest hit areas, the Garland Brook watershed, showed no visible erosion from the forest floor, but much erosion on the logging roads, which were unprotected. Inspection of the Wild River area, another currently operating sale, showed that what happened at Garland Brook was not necessarily unique.

However, logging-road erosion on the Wild River area was not due solely to hurricane storms. Snow melt runoff

was known to have caused serious damage. Before the hurricanes of this year hit the area, gullies on moderate slopes developed on skid roads that were not protected by water bars. By contrast, older skid roads on which water bars had been properly installed before gully erosion could get started show little soil loss.

Delaware-Lehigh
Experimental Forest

Daily measurements of streamflow, precipitation, groundwater levels, and soil moisture were continued for a fifth year to determine the streamflow regime of a 1,530-acre scrub oak watershed and to provide the data required for pre-treatment calibration. On completion of the calibration period the Dilldown watershed will be converted to commercially valuable timber and the effect on streamflow will be determined.

Studies of this type require continued maintenance of instruments and exercise of ingenuity to develop means of studying the hydrologic factors. Soil frost, for example, a difficult factor to study in the field, was studied this past year in the laboratory through the use of a home freezer. Using soils of different texture and controlling moisture content and temperature, two types of concrete frost were formed and studied.

To measure rainfall underneath scrub oak, long narrow troughs have been found convenient. Placed beneath the canopy, they sampled a larger variety of cover conditions than the conventional circular gages. Records showed, however, that when these gages were exposed in the open to measure total rainfall, not as much was caught as in the standard Weather Bureau type; some of the rainfall splashed out of the troughs. Accordingly, to prevent splash, sides of the trough were elevated, and a correction factor was applied to previous trough measurements.

Infiltration
Project

In cooperation with the Southern Forest Experiment Station, a 1-year survey was initiated to determine soil moisture and soil strength characteristics of major soil types in Pennsylvania, New York, Connecticut, Massachusetts, New Hampshire, and Vermont. Periodic visits are made to 138 sites to get soil-moisture samples and soil-strength measurements. This is part of a larger study in which the

Forest Service is cooperating with the Corps of Engineers. The staff in the Northeast consists of R. C. Moyle, B. O. Jones, and A. R. Eschner.

Pocono
Experimental Forest

Daily measurements of streamflow and precipitation were continued for watershed calibration. Test holes were dug for groundwater observations and a location was selected for well measurements.

Fernow
Experimental Forest

Streamflow and climatic records were taken for a third year on five experimental watersheds. Following their calibration, four of the watersheds will be subjected to different levels of timber cutting and the effect on quantity and quality of streamflow will be determined.

During the summer of 1952 a logging truck road was built in one of the ungaged watersheds on the forest. Previous to the construction of this road and periodically thereafter, paired water samples were taken from this and another undisturbed forested watershed, which serves as a control. Sediment analyses were made on these samples.

Before construction, the amount of suspended sediment in both streams was low at all times and well within standards for domestic consumption. After construction and before logging started, the amount of sediment in the stream from the watershed with the road increased, particularly after heavy rains. Water-sample analysis showed a maximum of 173 ppm. from this stream. At the same time, the control watershed sample analyzed only 8 ppm.

After several months most of the fine material washed away from the surface of the logging-road and the adjacent disturbed areas so that the level of sediment gradually approach the control.

Logging in this watershed began in November 1953. During rainy weather the amount of sediment in the water increased 20 to 30 times what it was before disturbance of the watershed. Where the water was once pure and fit for domestic use at all times, it now runs free of sediment only at very low flows.

Erosion control was also investigated. A study was made to determine if a vegetative cover, using chaff from local sources, could be established on skid roads. Several treatments involving mechanical disturbance and application of fertilizer and lime were tried. From 2 years of results: mechanical disturbance, raking in the seed by hand, had no effect; limed and fertilized plots had 40 percent ground cover at the end of the first year, and 59 percent at the end of the second year. Where amendments were not applied comparable covers were 26 and 34 percent.

In general, plots that were seeded, limed, and fertilized produced an effective erosion-retardant cover. Sparse vegetation on the other plots offers little protection against soil washing.

A study of rainfall intensities beneath a fully stocked hardwood forest canopy showed that under winter conditions intensities were reduced 15 to 20 percent with reduction of 5 to 10 percent for higher intensity summer storms. Greatest reduction was in those storms below 0.5 inch of rainfall per hour.

At the Fernow it has also been necessary to develop equipment to facilitate measurements. Often an aptitude for gadgetry is useful. For instance, an ordinary bucket has been converted into a stove for thawing ice and snow in rain gages. Devices have also been developed to permit one man to measure erosion from skid roads by cross-sectioning.

FOREST GENETICS

Controlled Pollination Studies

Most of our pine crossing has been confined to the white pines and to hard pines in the series Lariciones (the series that includes Scotch, red, Austrian, etc.). In the white pines we have obtained 11 different species combinations during the period 1947-1954. Two of these hybrid combinations are proving of interest because of their rapid growth (table 1).

Table 1.--Growth of 4-year-old white pines produced by controlled pollination

Parentage	Trees	Height
	Number	Inches
P. griffithii	10	13.5
P. griffithii x strobus	2	20.2
P. strobus x griffithii	122	20.2
P. strobus	29	15.5
P. strobus x ayacahuite	62	17.3

We now have a fairly complete species crossability pattern in the series Lariciones (table 2). Of 37 different species combinations attempted, 15 were successful and 22 were unsuccessful. Of the 14 reciprocal crosses, 11 gave the same results in both directions. So far none of the successful crosses involve our American red pine, but most of the Japanese and Chinese species have crossed with each other. The hybridity of most of the progenies has now been established in growth tests. Fifteen-year tests indicate hybrid vigor in thunbergii x densiflora and densiflora x sylvestris. A few of the hybrids (indicated in the table) could be mass-produced rather easily.

For the 1954 breeding season, interracial crosses were planned for white ash, sugar maple, and eastern white pine. Lack of flowering prevented us from making the ash crosses and most of the maple crosses. A total of 3100 flowers were bagged and pollinated on eastern white pine. Most of the pollinations were made with pollen from the South, because the northern pollen did not arrive until after the bagged females (in the Pocono Mountains) were past bloom. This pollen is being stored in the deep freeze for next year. The 1953-54 interracial crosses were moderately successful, yielding about 600 control-pollinated seeds.

Investigation Of White Pine Weevil Resistance

A preliminary study of genetic resistance to the white pine weevil was made in the summer of 1954. This study

Table 2.--Species crosses in the series Lariciones, 1937-41, 1948-54

Male parent, by native range	Female parent						
	America	Japan		China	Europe		
	resinosa	thunbergii	densiflora	tabulaeformis	nigra	mugo	sylvestris
America:							
resinosa	+	-	-	-	-	-	-
Japan:							
thunbergii	-	+	+	+	+	-	-
densiflora	-	+	+	-	+	-	-
China:							
tabulaeformis	-	+*	-	+	+		-
sinensis	-	+	+	+	+		-
yunnanensis		+*		-	-		-
taiwanensis	-	+	+				
massoniana	-	+*	-	-	-		-
Europe:							
nigra	-	+	+*	-	+		+
mugo	-		-				
sylvestris	-	-	+	-	-	-	+

+ Successful cross. - Unsuccessful cross.

*Seed sets high enough to indicate possibilities of mass-production.

established certain facts that will prove useful in planning further work.

A 5-acre western white pine plantation established in Otsego County, New York, in 1937 showed that it is possible to obtain a vigorous 5-needled white pine more resistant to weevil attack than the ordinary eastern white pine. As compared with nearby eastern white pine plantings of similar age, this planting had about the same growth rate, better form, and only one-fifth as many weevilings per tree. However, this western white pine has been very susceptible to blister rust and has failed to survive on wet soils. This planting, which is just starting to flower, offers promising parent stocks for the production of eastern white x western white pine hybrids in the near future.

The summer's work showed that there are probable racial differences to weevil attack. In one small racial test near Lowville (Tug Hill area), New York, trees from an Eagle Lake, Ontario, source had only half as many weevilings per tree as did the trees from Adirondack sources planted nearby. There were also probable racial differences in weeviling susceptibility in a Norway spruce racial test in Otsego County, New York.

The study uncovered another fact which promises to make the geneticists' work more difficult. At least in New York virtually all the eastern white pine plantings have the same (Adirondack) seed source, and most of the native stands are too small and variable for genetic selection work. Thus, we can use the existing stands in New York to study individual tree variability in weevil resistance but not to study racial variability.

Nursery
Cooperation

With the excellent cooperation of the New Jersey Department of Conservation and Economic Development we started this year to grow our control-pollinated seed in the Washington Crossing Nursery. The arrangement has proved very satisfactory; growth and survival have been as good as or better than in previous years in our experimental nurseries. We hope to continue the practice in future years, gradually abandoning our special experimental nurseries.

Northeastern Forest Tree Improvement Conference

The second annual meeting of the NEFTIC at Mont Alto, Pa., on August 25-26, 1954, was the second milestone along the road that will lead most certainly and effectively to practical forest tree improvement in this region. The Proceedings, which will be distributed early in 1955, were edited by E. J. Schreiner of the Northeastern Station.

Hybrid Poplars

We have recognized for a long time the need for distribution of a relatively large number of the most promising hybrid poplar clones for tests under the widest possible range of climatic and soil conditions. Since farmers could best provide the good soils and culture required to adequately test these hybrids, the problem resolved itself into finding ways and means to distribute a few cuttings of 3 or 4 clones to each of a large number of interested farmers throughout the entire country.

An approach to farmers throughout the nation became available when an associate editor of the FARM JOURNAL visited the Station in 1953 to obtain information for an illustrated article on the hybrid poplars. In advance of publication, arrangements were worked out for distribution of cuttings on a cooperative testing basis. Hybrid Poplars Make News ! appeared in the October 1954 issue of the FARM JOURNAL with the statement that "A limited number of cuttings are available at small cost to farmers who are willing to cooperate with the scientists in testing these new hybrids." Distribution was offered on a "first come, first served" basis.

A total of 6,037 requests were received from the 48 states and the District of Columbia by December 31. Requests for cuttings for shadetree use and for tests under conditions that were apparently not suitable for hybrid poplars were declined.

Since we estimated that we could supply a maximum of approximately 4,000 requests, a form for a cooperative agreement was sent to each of the 4,491 correspondents whose requests had been received by October 15. Correspondents in the Lake States, Plains Region, and West Coast were cautioned against attempting to test these hybrids on poor soils, or on dry sites without irrigation.

Table 3.--Response to offer of hybrid poplars for cooperative test planting

Region	Inquiries received (12/31/54)	Cooperative agreements sent out (10/15/54)	Cooperative agreements returned (1/4/55)
	Number	Number	Number
Northeastern (12 states and D.C.)	1,550	1,148	889
Southeastern (5 states)	376	243	166
Southern (7 states)	390	276	201
Central States (6 states)	1,721	1,269	1,021
Lake States (4 states)	1,093	827	587
Rocky Mountain (7 states)	437	343	268
Intermountain (4 states)	128	91	65
Pacific Northwest (2 states)	255	187	131
California	137	103	80
Canada and Alaska	8	4	1
Name or address omitted	--	--	7
Total	6,095	4,491	3,416

As of January 4, 1955, a total of 3,416 cooperative agreements had been returned. The distribution of inquiries and cooperative agreement forms sent out and returned is shown in table 3.

The job of making cuttings has now gone far enough to indicate that we can send 2 cuttings of each of 4 hybrids to every cooperator. A total of 70 of the most promising clones, representing 23 of the best parental combinations, will be distributed during late February and early March.

These clones (except a few with special possibilities) will be distributed for test in each of the six regions of the United States.

Under the cooperative agreement the persons receiving the cuttings agree to plant and care for them according to instructions, and to report on the condition of the cuttings 1 and 2 years after planting. These reports will add greatly to our knowledge of the adaptability of the hybrids to different soil and climatic conditions.

FOREST INSECTS

It would seem appropriate in this year of 1954, which marks the 100th anniversary of the beginning of economic entomology in this country, to preface our annual report with a brief history of federal forest-insect research in the Northeast.

A BRIEF HISTORY

The Federal Government began an intensive study of the gypsy moth in Massachusetts in 1905. From that year until 1928 research and control of the gypsy moth and other forest insects in the Northeast were carried on by the Division of Gypsy and Browntail Moths Control, Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture. In 1928 research was transferred to the Division of Forest Insect Investigations of that Bureau. Late in 1953 research and surveys were transferred to the Northeastern Forest Experiment Station.

In the early 1900's efforts were made to introduce from Europe and Asia parasites and predators of the gypsy and browntail moths. This work involved several expeditions to foreign countries. Techniques were developed for collecting, shipping, rearing, and colonizing these natural insect enemies. Taxonomic and biological studies of parasites and an evaluation of their effectiveness as control factors were undertaken. Many important contributions in the field of

biological control resulted. The Gypsy Moth Laboratory became a training school for many entomologists who later became outstanding leaders in biological control. The pioneer studies proved to be very helpful in setting up programs of parasite introduction for a number of other pests of foreign origin such as the satin moth, European pine shoot moth, larch case borer, European spruce sawfly, and so on, as well as in studies of the biological control of native forest insect pests.

Of equal importance were the contributions made in the fields of insecticide formulation and the development of equipment for applying sprays. Lead arsenate as an insecticide and the hydraulic sprayer were developed and were used extensively for many years in combatting the gypsy moth. In an effort to reduce the high cost of the lead arsenate-hydraulic sprayer control method, highly concentrated sprays were formulated and applied in atomized form so that a small volume of liquid would cover a large area.

These sprays, which were nearly 100 times more concentrated than the conventional sprays used in the hydraulic sprayer, were first applied by hand atomizers, knapsack sprayers, paint-spray assemblies, and other small improvised equipment. They were later tested in airplanes, autogyros, and helicopters. Several types of aerial distributing devices were developed. Most of the pioneer work in aerial spraying was done in the Northeast. The mist blower was later developed for applying concentrated sprays in finely atomized form from the ground. This spraying device is now rapidly replacing the hydraulic sprayer for shade tree pest control. When DDT appeared, the first test in applying this new insecticide from an airplane for forest insect control was made in a gypsy moth infestation in Pennsylvania.

Another project, designed to determine the alternate hosts of introduced gypsy moth parasites, involved the collecting and rearing of thousands of native forest insect larvae. A vast amount of information was thus obtained on the identity, life history, food plants, and parasites of our native forest and shade tree insects. This information proved to be of inestimable value in the preparation of the book "Insect Enemies of Eastern Forests."

Surveys were conducted from time to time to determine the status of certain forest insects, particularly during outbreak periods. This work, however, was given great impetus by the passage of the Forest Pest Control Act of 1948. Since that time much has been done toward the improvement in survey methods and techniques, and the ground work has been

laid for a detection and appraisal survey program for the Northeast.

The course of events of the past 50 years in forest insect research in the Northeast has had a marked influence on our present program. We have been impressed with the importance of natural factors in controlling forest insects and we are giving emphasis to studies designed to measure the controlling effect of these factors and to utilize biological methods of control to the fullest extent. These studies have taken on new meaning with the tremendous advances in chemical control, particularly airplane spraying. Knowledge of the controlling effect of natural factors becomes of great importance in determining when, where, and if direct control is needed.

In our studies of the natural control of forest insect outbreaks we have observed the resistance of certain forest stands to insect population buildup. This has pointed the way toward control through silvicultural practices and it is our intention to explore every possibility of developing methods for minimizing insect damage through forest management.

Since the discovery of DDT as an insecticide, vast numbers of new chemicals have appeared which must be tested against a variety of insects. In our present program considerable effort is being given to the formulation of new chemical sprays and to the improvement of equipment and methods for applying them.

We are endeavoring to develop a regional survey program which will keep us currently informed on the status of each of the important forest insect pests.

Through the years we have worked closely with the states, and cooperation and coordination of effort between state officials and federal entomologists has reached a high level. Excellent research and survey organizations have been built up by many of the Northeastern States. By pooling the efforts of the states and the Station a closely coordinated program for forest insect research and surveys should be developed.

REPORT FOR 1954

Our program of research is necessarily restricted to a few major problems. During 1954 the principal ones involved the spruce budworm, the white pine weevil, the Matsucoccus scale on red pine, and the balsam woolly aphid.

The Spruce Budworm

A heavily infested area of 20,000 acres near Madawaska Lake in Aroostook County, Maine, was successfully sprayed with DDT by airplane in June, for the control of the spruce budworm. Populations were reduced more than 99 percent. The operation was financed jointly by private timberland owners, the state, and the Federal Government.

The annual aerial survey conducted in July showed that the area noticeably defoliated was greatly reduced over that observed in 1953, with only small, scattered areas having medium to heavy defoliation. The egg-mass survey indicated that in the areas of heaviest infestation a decrease could be anticipated in 1955, but the area of light infestation would be somewhat larger than last season. In Vermont and New Hampshire the pest can be expected to remain at a low level. Natural control, particularly parasitism, was high at the regular study plots in northern Maine. Parasitism of large larvae ranged from 43 to 63 percent, of pupae from 17 to 44 percent, and of eggs 48 percent. Colonies of a western parasite (Phytodietus fumiferanae), propagated by the State of Maine, were released at three colony sites in northern Maine, and rearings of host larvae were conducted to provide material for a similar but reduced program in 1955.

White Pine Weevil

Biological and ecological studies of the white pine weevil were continued. In September 1953 several hundred adult weevils, "tagged" with Sc^{46}, were released near New Lisbon, N. Y. Winter mortality reduced the number of "tagged" weevils so much that a definite pattern of dispersion could not be established. Movements of living weevils, though, which were followed from April 9 through June 17, indicated that 75 percent of the movement was within 60 feet of the release point. The most distant weevil was found 450 feet away. In September 1954, 1600 weevils were tagged with Sc^{46} and released in the same area. Up to October 12, only 15 had moved from the release point and the most distant was only 96 feet away. After the releases were made 41 birds of 15 species were collected. Stomachs will be examined for weevils, and vital organs for the presence of Sc^{46}.

Releases of adult weevils were made under selected trees within a white pine plantation near Amherst, Mass., in

the fall of 1953. Half of the trees were within a tin barrier to exclude small mammals. The other half were unprotected. Recoveries of adult weevils in the spring indicated that small mammals had not preyed upon the weevils. This experiment is being repeated in 1954. Mammal censuses are also being taken at Petersham, Mass., and Moodus, Conn.

Collections of weeviled leaders have been made at regular intervals in Connecticut to determine the best method of sampling weevil parasitism, and regular observations are being made in an attempt to determine predation by birds on immature weevils.

An intensive study was initiated in 1953 at the Harvard Forest, Petersham, Mass., to determine the relative effect of various stand and individual tree factors on weevil populations. One block of 4 cover-class units was established. Pertinent data have been taken during 1954. No significant differences in the amount of weeviling in the 4 units was shown this year.

On April 30, two heavily infested plots of pines at Lowville, N. Y., were treated with Heptachlor and Endrin by airplane. The plots were 65 and 38 acres, respectively. Very poor control resulted; probably because an 8- to 15-mile wind was blowing at the time of spraying. Small-scale laboratory and field screening tests, however, indicated that both Endrin and Heptachlor were very toxic to the weevil. Four systemic compounds were also impressively toxic to weevils. They were Parazoxon, Chlorothion, OMPA, and Compound 12008. Tests using a knapsack sprayer were continued. Several stands were reclaimed by thinning and spraying. About 500 trees were sprayed in late fall, 1954 to determine the amount of control exerted by such early treatments on spring emergents.

Matsucoccus Scale
On Red Pine

Rather heavy mortality of scales occurred in the Bridgeport, Conn., area from abnormally low temperatures last winter and from predators. Populations still remain quite high. Mortalities at controlled temperatures are being studied in cooperation with the Boyce Thompson Institute at Yonkers, N.Y. Following preliminary screening tests a detailed insecticidal experiment was conducted in cooperation with the Bridgeport Hydraulic Water Company. A total of 48 plots were treated. Three chemicals (Systox, ethylene dibromide and 2 percent oil emulsion) applied by mist blower and hydraulic sprayer were used at 4 scheduled intervals.

The percent reduction obtained by any single application was not satisfactory for practical control. Timing was important: best results were obtained when the scale was in the intermediate stage or in the first larval stage of the summer brood, May 19 and June 8. No one insecticide or method of application showed definite superiority over another.

Limited insecticidal tests were conducted on Long Island in cooperation with New York State and Cornell University. In August, fifty-five 10- to 15-foot trees were treated. Systox, Malathion, and Chlorothion were applied with a hydraulic sprayer. All of the sprays caused heavy mortality, and Chlorothion appeared to be a very promising material.

Balsam
Woolly Aphid

Balsam woolly aphid infestations on 16 survey plots in the Green and White Mountain National Forests continue to build up and heavy tree mortality can be expected.

A study of tree mortality is being made on the southern district of the Green Mountain National Forest. A block of spruce-fir forest 30 x 100 chains is being appraised by ground methods and through the use of aerial color photography. Five 2½-acre photo-interpretation plots were suitably marked and then the entire area was photographed. Ground data will be compiled from 120 1/10-acre plots, a 4-percent sample.

A colony of the imported predaceous fly, Leucopis obscura, was collected in Maine and released in Vermont where it is not known to occur as yet. It is hoped that one or two more colonies may be obtained in 1955 from collections made late this fall, which are being overwintered at New Haven.

Birch
Dieback

Three of the five birch study areas on the Green Mountain National Forest were examined. All plots and cruise lines were remarked and all trees renumbered. Plots were re-examined at Speculator and Lewis, N. Y. Results are being assembled for a progress report.

Silvicides

Silvicides were tested at Hamden and Canton, Conn. with the object of working out a practical method for releasing white pines growing under hardwoods. Silvicides were applied to 75 plots; sixty 1/40-acre and fifteen 1/400-acre. Detailed results have been presented in a special report. Several chemicals appear to be promising. Three quarts of 2,4,5-T ester in 3 gallons of oil per acre for light to medium growth, and 4 quarts in 4.5 gallons per acre for dense growth of difficult-to-kill species appears to be adequate. Final results will not be available until next season when treated trees would normally refoliate.

Improvement Of Survey Methods

A sequential plan was devised for sampling larval and egg-mass populations of the spruce budworm, which effected a saving of about 42 percent in time required over methods used in previous years. A similar plan for sampling forest tent caterpillar egg-mass populations was worked out in cooperation with the New York State Science Service. This plan, based on data taken in New York in 1953, was used in New York, Vermont, and New Hampshire.

Development Of Equipment

A dual-nozzle system with a separate shut-off valve for each set of nozzles was developed for mist blowers. The system consists of a ring of finely atomizing nozzles surrounding a single nozzle which produces larger droplets. Using this equipment it is possible to obtain adequate spray coverage of tall trees whereas with the conventional system insufficient spray is deposited at the tops of such trees.

A model knapsack mist blower driven by a $2\frac{1}{2}$ hp. engine was designed and constructed in cooperation with the Homelite Corporation. The new machine weighs 36 pounds and is adjustable to deliver sprays with variable droplet sizes at different rates of discharge.

Dissemination Of Information

Approximately 400 requests for information regarding forest insects, forest products, and household insects were answered during the course of the year.

FOREST DISEASES

During 1954 the research and survey activities of the Division were continued as in previous years. New studies were initiated to determine the incidence of heart rot in red spruce, the distribution and severity of sweetgum blight, and the degree of resistance to chestnut blight in American chestnut trees that have survived many years of exposure to the disease.

In general, the forest disease situation remains unchanged. No spread was recorded of oak wilt into disease-free areas. The cool, wet weather in the spring and early summer caused outbreaks of various foliage diseases, such as white pine needle blight and anthracnose of sycamore and oak, but no serious losses are expected. A summary follows of the significant results obtained during the year.

Foliage Diseases

Cultural and inoculation studies indicate that the species of Septotinia on poplar and on Mayapple (Podophyllum) are probably distinct and incompatible. If confirmed, this means that control methods for leaf blotch of poplar, caused by S. populiperda, need not take into consideration the possibility of spread of the disease from Mayapple to poplar.

Data have been obtained on the relative susceptibility of species and hybrids of poplar to Marssonia leaf spot. An overwintering stage of the fungus, hitherto unreported in the United States, has been discovered and studies are under way to determine its importance in the spread of the disease.

A new and locally serious leaf spot of aspen species and hybrids was found in Massachusetts. It causes conspicuous premature defoliation. Studies have been started to determine its identity, distribution, and potential importance.

Stem Diseases: Rusts Of Conifers

The technique developed for the determination of the presence of the mycelium of the white pine blister rust fungus, Cronartium ribicola, in the bark and wood of infec-

ted trees has been revised to provide a rapid method of differential staining of microtome sections. The revised method will be published.

Stem Diseases:
Cankers

Study of the relative susceptibility of 202 hybrid poplar clones to Septoria canker was completed and the results were published as a departmental circular.

The 44 hybrid poplar clones that were most resistant to Septoria canker were tested for their susceptibility to Dothichiza canker by inoculations. These results, along with detailed observations on the occurrence of Dothichiza under natural conditions and an analysis of the significance of the disease in the poplar breeding program, are being prepared for publication.

Adequate surface sterilization of poplar cuttings can be obtained by treatment with Semesan and cuttings so treated survived and grew well in field plantings. Several publications on the various aspects of this work are available for distribution.

A detailed study has been completed of Valsa canker on spruce, Douglas-fir, balsam fir, hemlock, larch, and pine in plantations and natural stands. A manuscript has been prepared on the symptoms, causal fungi, cultural characteristics, pathogenicity, and control methods, with a discussion of the significance of the disease in forest stands.

A comprehensive investigation of Phomopsis canker on conifers is nearing completion. The identity and synonomy of the causal fungus has been clarified and the ascogenous or perfect stage described as a new species. Tests of the pathogenicity of the fungus have been conducted on species of larch, hemlock, spruce, Douglas-fir, pine and balsam fir. Positive results were obtained on the first four, with girdling cankers and dieback on Douglas-fir and lesser evidence of parasitic activity on the other three. A manuscript for publication is now in preparation.

Stem Diseases:
Dieback And Wilts

A species of Verticillium isolated from wilting yellow-poplar trees in Connecticut was inoculated on young nursery yellow-poplars. Twenty-seven out of 30 inoculations

caused a greenish discoloration in the wood. In 11 cases the streaks were conspicuous, and adjacent leaves wilted and died. The causal fungus is being compared critically with the species of Verticillium on other hosts.

A manuscript is in preparation presenting the results of a study of the role of the fungi isolated from the crowns and roots of yellow and paper birch trees in various stages of dieback in northern New England. Positive evidence has not been secured that any of the fungi obtained are significant as causes of the dieback.

Ten oak wilt control plots in Pennsylvania where CMU and 2,4,5-T were applied from a helicopter were reexamined. Results to date are promising with CMU but relatively unreliable with 2,4,5-T applied in this fashion.

Stem Diseases:
Discolorations And Decays

A manuscript for publication is being prepared on the relation of decay and other factors to the floatability of pulpwood bolts of red spruce and balsam fir. The conclusions from final analysis of the data are as follows: balsam fir bolts tend to sink more readily than red spruce bolts of the same size classes; the more sapwood, the more sinkage; sound top bolts sink more readily than those from lower levels in the same tree; the presence of rot increases the sinkage rate, and top rots are more important in this respect than butt rots; partial seasoning increases floatability; and peeling speeds up seasoning and thereby increases floatability.

A small study of the relation of heart rot in Virginia pine to some tree and site factors has been completed and the results are being prepared for publication. About 19,000 board feet of logs were cut, sawed into lumber, and scaled. The average age of the sample trees was about 70 years. Cull from decay was low, 1.8 percent of the gross scale, but incipient decay was present in an additional 15 percent. The presence of conks of Fomes pini on the trees was the only reliable indicator of decay. Most of the rot started at old branch stubs in the butt logs. Eighty-seven percent of all cull from rot was in the butt logs.

Noninfectious
Diseases

Needle blight of eastern white pine was unusually severe in 1954 throughout New England and New York. This

disease usually appears after a period of dry, hot weather following a prolonged period of cool, wet weather. Affected trees generally recover unless other complications arise. In New York a plantation of Balkan white pine, Pinus peuce, was blighted more severely than has ever been observed on P. strobus. Other exotic white pines examined were not affected.

Foreign Diseases Not Reported In The United States

About 32,000 references were added to the index of the diseases of foreign forest trees and of North American trees planted in foreign countries. A manuscript is being prepared for publication as a Departmental Handbook in three parts: Part I, Diseases of North American forest trees growing abroad; Part II, Diseases of foreign forest trees growing in North America; and Part III, Potential threat of foreign diseases to North American forest tree species.

Selecting, Breeding, And Testing Disease-Resistant Forest Trees

The testing of white pine selections and hybrids for resistance to blister rust was continued in cooperation with the State University of New York, College of Forestry. No infections were found on 24 resistant selections of western white pine. Additions to the field test of resistant eastern white pines included 145 grafted trees and rooted cuttings from 25 resistant selections in New York and New Hampshire, 1,200 seedlings from seed from resistant selections in eastern Canada, and 16 hybrid seedlings produced by the Station.

Selection and testing of American, Asiatic, and hybrid chestnuts for resistance to chestnut blight was continued. Scionwood was collected from 10 apparently resistant American chestnuts in five states for grafting onto American and Asiatic root stocks. Field tests continue to show the superiority of Chinese chestnut P.I. No. 58602 for forest planting. In 1954 about 6,000 seedlings of this chestnut were distributed. Two more field test plots of promising chestnut hybrids were established in New York and Alabama.

Diseases Of Forest Tree Seeds, Seedlings, And Transplanting Stock

In 1943 a disease of red spruce transplants was reported at the U. S. Forest Service Nursery, Parsons, W. Va.

Attempts to isolate a fungus pathogen from the roots of diseased stock indicated that adverse growing conditions in the nursery probably were responsible. Stock was graded into five classes from excellent to very poor on the basis of crown condition and root development, and 100 plants in each class were outplanted in forest soil in 1943. Examination in 1954 showed that mortality since planting varied from 31 percent for the better stock to 70 percent for the poorer stock, and average height growth of the residual trees varied from 7.9 feet for the better stock to 5.6 feet for the poorer stock. This indicates that diseased stock was decidedly unsatisfactory for planting. The results are being prepared for publication.

Detection And Appraisal
Of New Or Threatening Diseases

An outbreak of the beech scale-Nectria disease was discovered in the Green Mountain National Forest. This is the first recorded occurrence of the Nectria in Vermont. In the Catskill Mountain area of New York the disease continues to spread. Serious mortality of beech is predicted, as has already occurred in Maine and New Hampshire.

Oak wilt surveys were conducted by state agencies in New York, New Jersey, Pennsylvania, Maryland, Delaware, and West Virginia. No infections were found beyond the previous limits of distribution. Oak wilt has not been found in New York, New Jersey, Delaware, and New England.

Excessive dying of red oak in Cattaraugus County, N. Y., from unknown causes has been reported. The oak wilt fungus has not been isolated from any of the dying trees after numerous attempts.

In cooperation with state forestry organizations, sweetgum blight surveys were made in Maryland and Delaware. The results will be combined with the data secured in a federal sweetgum blight survey over the entire commercial range of sweetgum and a comprehensive report will be published.

Anthracnose of sycamore and oak was epidemic in 1954 from West Virginia north to southern New York and New England. Sycamore refoliated and no mortality was observed. Some infected oaks on dry sites died during late summer.

Appraising Forest Disease Losses

For the 12 states served by the Station, estimates of annual losses from forest diseases were made in both cubic feet and board feet. Losses were estimated for birch dieback, the beech bark disease, hardwood cankers, sweetgum blight, white pine blister rust, heart rots, and miscellaneous diseases. The results will be included in the Timber Resources Review of the Forest Service.

Decay Of Wood In Use

Additional confirmatory evidence was obtained of the effectiveness of soil covers under basementless houses in preventing and controlling decay in subfloor timbers. About 90 houses where materials are under test were reexamined. Significant results obtained or verified during the year are that soil covers are equally effective in all regions east of the Mississippi River; that materials satisfactory for use as soil covers are asphalt-covered papers with a smooth finish, waterproofed laminated papers, and thin metal foils; and that it is safe to use soil covers without ventilation of crawl spaces.

Eight promising chemicals (compounds containing copper, zinc, mercury, arsenic, and phenol) were tested as soil toxicants for eradicating infections of four common soil-inhabiting building-rot fungi. The results are not yet available.

Measurements of the rate of growth of two building-rot fungi, Merulius lacrymans and Poria incrassata, in planks of red and white oak, shortleaf pine, and Douglas-fir, show that in less than 4 years the two fungi have advanced 8 feet in the pine and oak and 7 feet in the Douglas-fir.

Natural Resistance Of Woods To Decay

After 10 years in a field test in Virginia, fence posts of untreated wood of Japanese and American chestnut, black locust, and chestnut oak were examined. All species are quite durable but the black locust and Japanese chestnut posts are in better condition than those of the other two species.

A test of the relative resistance to decay under field conditions of the wood of 40 tree species (23 native and 17 exotic) was initiated in 1953 in Maryland. The experiment will run for a 2-year period with one-quarter of the test blocks being removed at 6-month intervals. In 1954 the blocks under test for 6-month and 1-year periods were removed and the weight loss was determined. The results are not yet available.

FOREST ECONOMICS

THE FOREST SURVEY

Forest Inventory

Field crews surveyed about 4,594,000 acres in the Northeast in 1954. The total acreage covered by field inventory now amounts to 58,557,000 acres--nearly 77 percent of the initial survey job. Massachusetts and Pennsylvania became the eighth and ninth states in the region to be completely surveyed. Field work was carried on in Maine, where about 10 percent is now covered. Only the states of Maine, New Jersey, and Delaware remain to be surveyed in the Northeast.

In addition to the acreage above, another 1,689,000 acres were resurveyed in Pennsylvania. Warren, Elk, Forest, and McKean Counties were surveyed originally during the spring and summer of 1947. The resurvey will be used to adjust the original data.

Cooperation from the states and private industry continues to be excellent. Aerial photographs were provided by the states of Pennsylvania and Massachusetts, and by the S. D. Warren Company of Westbrook, Maine. Office space was provided by the State of Pennsylvania and by the Harvard Forest at Petersham, Mass.

Type
Maps

Field type-mapping has been kept up to date except in Pennsylvania. Work remains to be done for a few counties. This work will be completed during the winter.

Timber
Cut

The report for Maryland was revised to incorporate 1952 estimates of timber cut. Several man-weeks were spent on a small-sawmill canvass in cooperation with the Bureau of the Census. Wood-utilization studies were carried on in New Jersey and Maine, though not completed in either state.

Station notes were prepared showing relationship of stump diameters to d.b.h. (diameter breast high) for white pine, sugar maple, and beech. Preliminary drafts for two additional Station notes have been prepared. One will show the relationship of limbwood volume to growing-stock volume in hardwood sawtimber trees. The other will show the proportion of material cut for sawlogs and pulpwood that comes from poletimber size trees and from sawtimber size trees.

Reports

Unit reports for New York Forest Districts 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, and 15 were printed during the year. Revised unit reports for Districts 1 and 7 have also been printed. The New York State statistical report was prepared and will be published early in 1955. A first draft of the forest resources report for New York has been written in cooperation with the State University of New York College of Forestry, and the New York Conservation Department.

Four unit reports have been prepared for Pennsylvania and submitted for publication, and a start has been made on the statewide report. The state report for Maryland has been prepared and is now being reviewed. Reports for Massachusetts, Connecticut, and Rhode Island are now being written and should be ready for publication next summer.

The New Hampshire Forest Resources report has been published and distributed by the Department of Agriculture.

RESOURCE - ECONOMICS

During 1954 the Division of Forest Economics was reorganized into two sections: Forest Survey and Resource-Economics. Both sections participated in the forest survey, the major project of the Division. The Resource-Economics section prepared the forest survey analytical reports that are noted above. Both sections also undertook important parts of the Station's assignment under the nationwide Timber Resource Review, which is now nearing completion. In addition to these projects there were a number of other studies carried on by the Resource-Economics Section.

Marketing Of Forest Products

A regional study of the organization and structure of forest-products markets, mentioned last year, has been continued in cooperation with eight agricultural experiment stations. Computations for the first phase of this study have been completed and the data have been prepared for the regional interpretation. In the three states for which the Station is carrying on the work, field surveys are in progress for the second phase of the project.

Another continuing project is concerned with the development and testing of log grades for both softwood and hardwood species. The Forest Service Interim Grades for Southern Pine were tested on white pine and other softwoods. A paper was prepared on log-grade improvements. And the Station participated in sawmill clinics sponsored by the New York State College of Forestry; in a hardwood log-grade school for personnel of the Central States Forest Experiment Station; and in a cooperative log-grade study in Illinois and Indiana.

A study was started on the problems of marketing mine timbers in West Virginia. Field measurements for a study of strength values of timbers used on farms has been completed.

Resource Analysis

Several analyses of the resource situation were prepared during the year. The current pulpwood supply situation in the Northeast was described. For a conference on hardwood pulping, the hardwood resources of New England and New York were analyzed. At the request of the Altoona, Pa., Chamber of Commerce, a plan was prepared for surveying and

analyzing the timber-resource base and the prospects for forest-industry development in that area. The problem analysis, upon which forest research in the Anthracite Region of Pennsylvania is based, was brought up to date. And assistance was given to the regional office of the Forest Service in preparing a description of surplus hardwood timber in the Middle Connecticut Valley.

FOREST UTILIZATION

The Station's Forest Utilization Service has, over the 10 years since its establishment, carried on a long series of jobs all pointed toward the full and efficient use of the region's forest raw materials by forest-products industries and other timber users. The 1954 activities followed the pattern established in the past. Acting as problem analysts and also as a connecting link between the Forest Products Laboratory and the field, the Station's FUS staff not only works to insure that wood growers and users have the latest technical information on wood utilization, but it also stimulates and works to coordinate research of local agencies with that of the Laboratory and with each other.

The Station's FUS unit operates in 10 broad technical fields, defined as follows:

1. Timber harvesting and conversion.--New and improved methods of harvesting and transportation; log grades; small sawmill operation; machining properties of wood; and increased utilization in the woods, mills, and factories.

2. Growth-quality relationships.--The effects of growing conditions on wood quality, the identification of woods, the relation of wood structure to its properties, and information on foreign words.

3. Wood chemistry and products derived from wood.--Fundamental chemistry of wood and chemical utilization of wood residues; charcoal; wood sugar; lignin; particle boards, and dimensional stabilization of wood.

4. Use of wood in construction.--Strength properties of wood; plywood; laminated construction and fiberboard; properties of joints and fastenings; and structural utilization of wood.

5. Use of wood in containers.--General principles of efficient construction of wood and fiber containers, including suggestions for improvement in designs to effect economies and better performance.

6. Wood seasoning and physical properties.--Methods of air drying, kiln drying, and special drying processes; demonstrations in kiln drying; moisture control in storage and handling; electrical properties; wood bending; shrinkage and swelling effects in fabrication; and condensation control in housing.

7. Protection of wood in service.--Protection of wood from decay, insects, marine borers, fire, and weathering; service tests of treated materials; effects of temperature and time on wood properties; application of paints, water repellents, and other wood finishes.

8. Glues and glued wood products.--Properties and uses of glues; production of veneer, plywood, glued laminated members, and other glued assemblies.

9. Pulp and paper products.--Methods of improving the yield and quality of wood pulp; developing and improving pulp and paper products; and the use of poor-quality wood, wood residue, and little-used species.

10.--Decay, stain, and mold.--Cause and control of fungus defects in semimanufactured products and wood in use, tests of natural decay resistance, improved laboratory methods of detecting and evaluating fungus damage.

Since this is a continuing program and since the technical and industrial activity involved is dynamic, not all fields are covered in equal detail and at the same level in any year. Sometimes effort is placed on new research activities (problem analyses, pilot testing, and cooperative studies). At other times it is placed on service to persons or groups interested in or in a position to promote the use of research (individual firms, societies, associations, etc.). But always its work program is directed toward one or more aspects of its broad objective, such as: (1) improving the utilization of unpopular species; (2) securing the most complete utilization of low-grade material, and elimination or use of so-called woods waste; (3) making wood used

as wood serve the user better through use of treatments that improve its properties; and (4) extending the field of usefulness of wood, by increasing its marketing possibilities, or improving its position as a basic raw material for industry.

Perhaps the largest influence on the Station's utilization activities is the presence of a large regional reservoir of poorly utilized low-grade wood. The most effective approach to its solution has seemed to be through improved harvesting, conversion, and seasoning practices, which would lower costs and improve the quality of the product. Consequently these are the fields on which most emphasis has been placed. That the Station has established itself well in this field is shown by the fact that of over 400 mail and phone requests for information received directly in 1954, 300 dealt with the problems in these fields. Activities in the other fields have stimulated the flow of inquiries directly to the Laboratory, and it is estimated that over 5,000 such inquiries are submitted annually from this region.

Whereas in 1944 there were relatively few local or national organizations working to improve the utilization of wood, today there is a considerable number in this region alone. In addition, forestry schools are giving more attention to research in utilization problems. An outstanding development, for example, was the breaking of ground in 1954 for a $2,000,000 laboratory to be devoted to wood research at the State University of New York's College of Forestry at Syracuse. In conformance with general Station policy--and to stretch our limited resources--cooperation with all research agencies is the keynote of the forest utilization program.

During the year special attention was given to four important fields. These were the pulp and paper industry, the pallet industry, development of debarkers and chippers, and the kiln drying of white pine.

Pulpwood
Industry Study

The purpose of this study was to determine the problems arising in connection with the increased use of hardwoods by northeastern mills. Twenty-seven pulp mills were visited and the situation was discussed with top management. Effort was made to select smaller mills because it was a known fact that larger mills are generally well informed on technical developments. The major portion of raw material

in over one-half of the mills visited was hardwood, and most of the other mills were considering the use of some hardwood or already use some and were planning to use more. This desirable upward trend in the use of hardwood appears to be general. In 1944 northeastern mills used less than 600,000 cords of domestic hardwood for pulpwood. In 1954 they used about double this. Almost one-third of the total domestic wood used is hardwood.

The study indicated that technical problems are well on the way toward solution and that additional increased use of hardwood revolves around factors that can be classed as educational or economic. The general conclusion about the future of hardwood-pulpwood use is well stated in a report by the Federal Reserve Bank of Boston. This is a report on a conference on hardwood pulping, held at the University of Massachusetts and sponsored by the Northeastern Wood Utilization Council. This report states that there is a substantial market in southern New England and other parts of the Northeast for hardwood pulp; that ample supplies of wood exist and getting it cut and delivered to the mill is no problem; that hardwood pulps suited to the local paper mills can be produced economically and at less than competitive cost; that local mills can certainly not make 100 percent substitution of pulps now being used, but such substitutions can reach substantial proportions without loss and in some respects with some improvement in quality of paper.

Pallet
Industry Survey

With the cooperation of the Wood Pallet Manufacturers' Association, a look was taken at the pallet industry as a user of low-grade wood. It was found that this business constitutes an important outlet for material of this character, and will undoubtedly continue to do so. As is frequently the case, most of the problems facing the industry are economic rather than technical. However, there are some technical problems, the biggest of which lies in the seasoning field. Although dry lumber makes the best pallets; drying defects render its use uneconomic, according to many producers.

Debarkers
And Chipper Study

The Forest Products Laboratory is making a nationwide study of equipment designed to debark and chip logs, bolts, and mill residues. The Station and the Laboratory techni-

cians took a look at the situation in the Northeast, where there is strong interest in this field and where both equipment manufacturers and industries are devising and testing a variety of items. The general impression gained by the investigators was that ideal equipment for the typical small New England operator is not yet available and the cost of equipment that is available is high. One northeastern debarking and chipping machine development looks as good as any in the field. The search, of course, is for a setup that is reasonably inexpensive to buy and operate, that is mobile, and that is capable of producing bark-free chips suitable for any pulping process.

Study Of Kiln-Drying Practices With White Pine

Fifteen sawmills and concentration yards handling white pine were visited in 1954 and their kiln practices were analyzed. In general, adequate kiln-drying equipment is available and reasonably well-trained men are available to operate it. The study showed, however, that for the most part there is failure to use the equipment efficiently. This is due in some cases to poor kiln design; in others, however, it is due to poor maintenance, to lack of adequate technical information, or to the necessity for exceeding reasonable production capacity.

To a large degree, failure to do a precision drying job stems back to lack of dryness standards on the part of consumers. What is needed is an increased awareness by both producers and users of the part that moisture plays on wood performance; refresher courses for kiln operators; and a kiln tune-up or modernization program. In addition, there are some technical problems. These revolve chiefly around wet-pocket material and the development of "coffee stain." In general, adequate schedule information is available.

Other Activities

In addition to these studies, our utilization staff maintained a series of soundings into such things as the charcoal business, chemical debarking, logging and milling equipment developments, integrated woods and mill operations, timber quality standards, wood-particle boards, and laminated flooring. Also, as in past years, it was active in most of the key utilization organizations of the region.

In getting research results into use, both the Station's utilization staff and the Laboratory cooperated with the State University of New York College of Forestry, the forestry departments of the University of Massachusetts and the University of Maine, and the Vermont Forest Service. Seven training sessions for small mill operators, a 1-week clinic for kiln operators, and a demonstration of log and tree grading and bucking were arranged. Minutes of the second meeting of the Northeastern Wood Preservation Conference were prepared by C. R. Lockard and published by this Station. Fred C. Simmons acted as logging engineering editor of THE NORTHEASTERN LOGGER, the magazine of the Northeastern Loggers' Association.

The preparation of a series of papers on beech utilization has been a continuing project. Of this series, which is the result of the collaboration of 14 forestry agencies, 10 have been published to date. The following are now available.

Some Physical and Mechanical Properties of American Beech, 1951.
Storage of Beech Logs and Bolts in the Northeast, 1951.
The Steam-Bending of Beech, 1952.
The Chemistry and Chemical Utilization of Beech, 1952.
Gluing Techniques for Beech, 1953.
Beech for Veneer and Plywood, 1953.
Beech for Containers, 1953.
Beech for Flooring, 1953
The Machining of Beech, 1954.
Logging Beech, and Specifications for Beech Products, 1954.

A very important job in cooperation with the American Standards Association was undertaken. The American Standards Association has a project designed to develop: (1) a tolerance goal for thickness variation in lumber, and (2) a manual showing how small mills should be set up, maintained, and operated to produce lumber within the stipulated limits. This was initiated to reduce waste and improve efficiency at such mills. The tolerance phase of the work was undertaken by a task force of the American Society of Mechanical Engineers, while compilation of the manual was delegated to the Forest Products Research Society national committee on logging and milling. Station utilization men head both these efforts. As a basis for setting the tolerance limits, a cooperative nationwide study was made of sawing practice in nearly 200 small mills. It was found that most mills were cutting 50 percent of their boards more than 1/8-inch over or under the size the setworks were set for. Experts believe, however, that through the use of methods described in

the maintenance manual (now in rough draft), it will be possible to hold 90 percent of production of boards within the overall limit of 1/4-inch. Recommended maximum variation for plank and joists is 3/8 inch and for timbers 1/2 inch.

1954

PUBLICATIONS

by staff members and cooperators of the
Northeastern Forest Experiment Station,
Forest Service, U. S. Dept. Agriculture

Anonymous.
1954. CHESTNUT BLIGHT AND RESISTANT CHESTNUTS.
U.S. Dept. Agr. Farmers' Bul. 2068. 21 pp., illus.
Describes the chestnut blight and how it killed off the American chestnut, once one of our most valuable native timber trees. In a search for blight-resistant trees, oriental chestnut trees are being tested, and hybrids are being bred. Management of chestnut orchards on the farm is outlined. (Publication was prepared by J.D. Diller and G.F. Gravatt.)

*Beattie, R. Kent, and Diller, Jesse D.
1954. FIFTY YEARS OF CHESTNUT BLIGHT IN AMERICA.
Jour. Forestry 52: 323-329, illus.
Tells how the chestnut blight, a fungus disease that came in from Asia, wiped out the American chestnut. All attempts at control failed. Blight-resistant oriental chestnuts have been introduced; and hybrid trees have been bred that have the American timber form and the oriental resistance. There is hope that these can be used to re-establish chestnut trees in American forests.

*Bickford, C. Allen.
1954. THE PLACE OF INDIVIDUAL-TREE DATA IN ESTIMATING GROWTH. Jour. Forestry 52: 423-426.
Growth estimates based on remeasured plots are recognized as the best available. But is it desirable to keep separate records for each tree on every plot? This reduces the sampling error, but gathering these data boosts the cost by about 30 percent. The best solution seems to be compromise: take individual-tree data from a sample of trees on the sample plots.

Bjorkbom, John C.
1954. FUTURE PULPWOOD SUPPLY--NEW ENGLAND-NEW YORK.
Northeast. Logger 2 (5): 17, 32.
The timber volume on commercial forest land in New England and New York is estimated at 443 million cords, 40

*Copies or reprints available from the Northeastern Forest Experiment Station, 102 Motors Avenue, Upper Darby, Pa.

percent softwood and 60 percent hardwood. Because of heavy drain on softwoods, the pulp industry cannot depend on the softwoods for its future supply. But it can draw on the large surplus of hardwood growth, sound cull material, and logging and milling residues.

Brown, Raymond C.

1954. FOREST INSECTS. In Forest Research in New England. Northeast. Wood Util. Council Bul. 42: 38-46.

A general survey of the status of forest-insect research in New England. A great variety of important studies are under way. Major insect pests are listed, along with agencies studying them, and kind of studies being made.

1954. GENETIC VARIATION IN RESISTANCE OF TREES TO INSECT ATTACK. Northeast. Forest Tree Improve. Conf. Proc. 1: 30-32.

Little is known about why insects prefer certain species or even certain trees. Several studies of resistance are described. Need is seen for work in the Northeast to develop a white pine that is resistant to white pine weevil attack. There is evidence of weevil-free plantations.

Campana, Richard J.

1954. CORTICIUM GALACTINUM DOES NOT CAUSE WHITE PINE NEEDLE BLIGHT. U. S. Dept. Agr. Plant Dis. Rptr. 38 (4): 297-303, illus.

No evidence was found in tests to support the view that Corticium galactinum causes needle blight of white pine. Though the fungus was found in leaf litter, it could not be isolated from roots of trees it was reported associated with. Attempts to inoculate seedlings with the fungus failed.

*Church, Thomas W., Jr.

1954. MICE CAUSE SEVERE DAMAGE TO VIRGINIA PINE REPRODUCTION. Northeast. Forest Expt. Sta., Forest Res. Note 35. 2 pp., illus.

Damage to a young stand of Virginia pine in Maryland was attributed to meadow mice (Microtus pennsylvanicus). About 60 percent of the Virginia pine were damaged, and some pitch pines were damaged. The study showed that the mice have a strong preference for Virginia pine. They did not attack hardwoods.

Clark, Thomas G.

1954. SURVIVAL AND GROWTH OF 1940-41 EXPERIMENTAL PLANTINGS IN THE SPRUCE TYPE IN WEST VIRGINIA. Jour. Forestry 52: 427-431.

In 1940 planting experiments were begun to explore methods of reforesting former red spruce sites in the south-

ern Appalachians. This is a report on survival and growth after 10 years. Effects of vegetative cover, release cutting, and poor rocky site are discussed.

*Crosby, David.

1954. HOW TO CONTROL THE WHITE PINE WEEVIL WITH A HAND SPRAYER. Northeast. Forest Expt. Sta., Forest Res. Note 30. 3 pp.

Detailed instructions for use of knapsack sprayer and lead arsenate for hand-spraying leaders of white pine trees to prevent weevil damage. Tells when to spray, what materials to use, formula and mixing procedure, equipment needed, how to spray, how often to spray, and salvage spraying.

1953. THE VARIATION WITHIN INJURY CLASSES FROM YEAR TO YEAR IN THE NORTHEASTERN STATES. Canada. Dept. Agr. Rpt. Symposium on Birch Dieback: 159-162. (Ottawa.)

Brief summary on results of survey of birch condition throughout the Northeastern States. The general trend of birch still seems to be downward.

*Cunningham, Frank E.

1954. METHODS OF ESTABLISHING PLANTATIONS OF HYBRID POPLAR CUTTINGS. Northeast. Forest Expt. Sta., Sta. Paper 66. 10 pp.

Hybrid poplars are now being tested in plantations throughout the Northeast. The author describes experience in establishing plantations at Williamstown, Mass.: site preparation, planting methods, cultivation, and costs.

*Diller, Jesse D.

1954. DECAY UNDER BASEMENTLESS HOUSES PREVENTED BY SOIL COVERS. Northeast. Forest Expt. Sta., Forest Res. Note 36. 2 pp., illus.

Moisture vapor rising from the soil under basementless houses will condense on wood during cold weather, permitting fungi to attack the wood and cause serious decay. Soil covers such as roll roofing, laminated papers, and thin metal foil check the movement of moisture from the soil and keep wood sills too dry for fungi to grow.

1954. CONTROLLING DECAY IN SUBFLOOR TIMBERS OF BASEMENTLESS HOUSES WITH CRAWL SPACES. Jour. Housing 11 (9): 348-350.

See above.

*Diller, Jesse D.

1954. A POTENTIAL TIMBER-TYPE CHINESE CHESTNUT. Northeast. Forest Expt. Sta., Forest Res. Note 37. 4 pp., illus.

Of many Chinese chestnut trees tested in attempts to find a replacement for the blight-killed American chestnut, the Chinese chestnut P.I. 58602 seems to have good possibilities as a timber crop.

---------- and Huang, S. W.

1954. AN EXPERIMENT IN GROWING MERULIUS LACRYMANS AND PORIA INCRASSATA UNDER ROOT-CELLAR CONDITIONS. Phytopathology 44 (7): 388. (Abstract.)

Beams of oak, pine, and Douglas-fir, made by bolting together 8-foot-long 2 by 4s, were placed in a root cellar in pails of soil infected with the fungi. During 2½ years the two fungi advanced at about the same rate. The infection started latest in Douglas-fir. Both fungi seem more active in spring and summer than in fall and winter.

---------- and Koch, E. J.

1954. EXPERIENCE IN GROWING MERULIUS LACRYMANS AND PORIA INCRASSATA UNDER FOREST CONDITIONS. (Abstract.) Phytopathology 44 (7): 388.

The two fungi, seldom grown successfully out of doors, were established in a small wooded area on 2- by 8-inch wedges of durable hardwood species. Leaves and asphalt-saturated paper were used as insulation to maintain high humidity and favorable temperature. After 6 months, decay (based on weight loss) ranged to more than 50 percent.

Fenton, Richard H.

1954. SAFETY GUARD FOR PULPWOOD LOADERS. Northeast. Logger 2 (8): 10, illus.

Offers safety rules for men feeding pulpwood onto conveyor-loaders. A sheet-metal guard, to cover the exposed sprocket and chain assembly, is described and illustrated.

Filip, Stanley M.

1954. NYLON HAIRLINE FOR STAFF COMPASS. U.S. Forest Serv. Fire Control Notes 15 (1): 19.

Clear nylon fishing leader was used in an emergency to repair a broken hairline on the front sight of a staff compass. Being translucent, the nylon hairline proved much better than wire or horsehair for sighting under forest conditions.

*Ford, Harold F.
1954. EFFECT OF STERILIZING TREATMENTS ON SURVIVAL AND GROWTH OF HYBRID POPLAR CUTTINGS. Northeast. Forest Expt. Sta., Forest Res. Note 33. 3 pp.

Hybrid poplar cuttings sterilized with three effective fungicides--mercuric chloride, Ceresan M, and Semesan --were tested in field plantings at Beltsville, Md. Mercuric chloride treatment affected survival most (more than half died). With Ceresan M, 24 percent died. Semesan treatment had no harmful effects. Greatest average height growth was made by Semesan-treated cuttings.

*---------- and Snow, Albert G., Jr.
1954. SUMMER IS THE BEST TIME TO THIN HYBRID POPLAR PLANTATIONS. Northeast. Forest Expt. Sta., Forest Res. Note 40. 2 pp.

A study on the Beltsville Experimental Forest showed that summer thinning is better than winter thinning for two reasons: the stumps have fewer sprouts, and the surviving sprouts are only half the size of those from stumps cut in winter.

---------- and Waterman, Alma M.
1954. EFFECT OF SURFACE STERILIZATION ON SURVIVAL AND GROWTH OF FIELD-PLANTED HYBRID POPLAR CUTTINGS. U.S. Dept. Agr. Plant Dis. Rptr. 38 (2): 101-105.

Field tests of hybrid poplar cuttings sterilized to prevent transmittal of fungus diseases showed that best results are got by using Semesan. Cuttings treated with it survived better than those treated with Ceresan M (94% vs. 76%) and made almost twice as much height growth. (See also Waterman and Aldrich, Plant Dis. Rptr. 38 (2): 96-100.)

*Gilbert, Adrian M.
1954. WHAT IS THIS THING CALLED GROWTH? Northeast. Forest Expt. Sta., Sta. Paper 71. 5 pp.

Suggests a new approach to use of growth data. The basic elements related to growth--accretion, mortality, ingrowth, net growth, production, and volume increase--are defined; and an example shows how they are used to figure how much timber can be cut during a growth period.

Gravatt, G. F., Diller, J. D., and others.
1954. BREEDING TIMBER CHESTNUTS FOR BLIGHT RESISTANCE. Northeast. Forest Tree Improve. Conf. Proc. 1: 70-75.

Reviews history of efforts since 1909 to breed chestnut trees for blight resistance. Outlines problems and progress in selection of parents, breeding experiments, performance under forest conditions, vegetative propagation and

grafting, and tests for resistance. Results indicate that blight-resistant, timber-type chestnut hybrids can be produced and that quality of trees will be continually improved.

*Grisez, Ted J.

1954. RESULTS OF A MOUSE CENSUS IN A SPRUCE-FIR-HEMLOCK FOREST IN MAINE. Northeast. Forest Expt. Sta., Forest Res. Note 28. 2 pp.

A mouse census was made in connection with a study of seedbed preparation. An average of 11.7 mice per acre were caught. All but a few were red-backed mice (Clethrionomys gapperi).

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1954. 1954 HURRICANE DAMAGE ON PENOBSCOT EXPERIMENTAL FOREST. Northeast. Forest Expt. Sta., Forest Res. Note 39. 2 pp.

The hurricanes "Carol" and "Edna" that struck inland over New England in the summer of 1954 caused some timber losses, but the damage was neither so extensive nor so severe as the damage done by the hurricane of 1938 and the storms of 1950.

*Hampf, Frederick E.

1954. RELATIONSHIP OF STUMP DIAMETER TO D.B.H. FOR WHITE PINE IN THE NORTHEAST. Northeast. Forest Expt. Sta., Forest Res. Note 38. 4 pp., illus.

Stump diameter-d.b.h. relationships for white pine were worked out from data gathered on logging operations in 10 states. Relationships are shown in graph form. This graph is expected to give reliable d.b.h. estimates for white pine anywhere in the Northeast.

Hansbrough, J. R.

1953. HISTORY OF BIRCH DIEBACK IN NEW ENGLAND. Canada Dept. Agr. Rpt. Symposium on Birch Dieback: 6-7. (Ottawa.)

Brief review of the decline and death of birch on cutover lands, and of research made to determine the cause. Insects, increased light, drought, and virus have been suggested as causes.

1953. THE SIGNIFICANCE OF THE FUNGI AND VIRUSES ASSOCIATED WITH BIRCH DIEBACK. Canada Dept. Agr. Rpt. Symposium on Birch Dieback: 128-135. (Ottawa.)

Describes in some detail studies made since 1945 to ascertain the cause of birch dieback. Of many fungi isolated from crowns of dieback birch, none has been proved pathogenic; of fungi isolated from roots and soil, only one has

been isolated often enough to be a suspect. No causal relationship has been found between virus and birch dieback. In short, birch dieback has been investigated very well, but no positive evidence of the cause has been found yet.

Hansbrough, John R.

1954. FOREST DISEASES. In Forest Research in New England. Northeast. Wood Util. Council Bul. 42: 47-49.

A brief and general discussion of forest-disease research in the Northeast. The greatest immediate need seen is for increased application of research results already on hand.

1954. GENETIC VARIATION IN DISEASE RESISTANCE OF NATIVE FOREST TREE SPECIES. Northeast. Forest Tree Improve. Conf. Proc. 1: 26-30.

Cites evidence to show that genetic variation in resistance to diseases does occur and can be obtained through improvement work. Urges that in any tree-improvement program, resistance to pests of allsorts must be recognized as one of the main objectives.

1954. (EXPERIMENTAL USE OF HELICOPTER IN OAK-WILT CONTROL.) Dutch Elm Disease, Elm Phloem Necrosis, Oak Wilt Conf. Rpt.: 65-66.

One way being tried to control oak wilt is to poison trees around infected trees to prevent spread of the disease. Since many infections are in isolated areas, a helicopter was used to spread poisons (2,4,5-T--some with DDT and pentachlorophenol added--and chlorinated methyl urea pellets) on ten 1/5-acre test plots in Fulton County, Pa. No reports on results available yet.

Hart, A. C.

1954. HARDWOODS NOW PREDOMINATE ON BURN AT CENTERVILLE, MAINE. Jour. Forestry 52: 360-361.

Despite airplane sowing of white pine seed, a softwood tract that was burned in the 1947 forest fire is now being taken over by hardwoods. Aspen, birch, and red maple were found on 83 percent of the study plots, softwood seedlings on only 7 percent.

*Holcomb, Carl J.

1954. IMPROVEMENT CUTTINGS ON FARM WOODLANDS BRING GOOD DIVIDENDS. Northeast. Forest Expt. Sta., Forest Res. Note 31. 2 pp.

Two small areas typical of farm woodlands in West Virginia were treated with four annual conditioning cuts.

Results show that West Virginia farm woods, managed with equipment the farmer already has, could be made to yield a much better part of the farm income.

*Hough, A. F.

1954. THE CONTROL METHOD OF FOREST MANAGEMENT IN AN AGE OF AERIAL PHOTOGRAPHY. Jour. Forestry 52: 568-574, illus.

Describes how the methode du control (continuous inventory system) can be used in making forest-management plans for timber production. The control method can be modified to provide for large-scale application by using modern forest-survey methods of aerial photography and statistical sampling. Use of de Liocourt's quotient is suggested for determining allowable cut. Practical operation of the method is described.

1954. STILT ROOTING.
Pa. Forests 44: 67, illus.

Certain tree species have rooting habits that are quite adaptable, and individual trees can survive in rather odd situations. Examples of hemlock and white pine trees that have survived by developing stiltlike roots are described.

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1954. GROWTH RESPONSE IN ALLEGHENY HARDWOOD FORESTS AFTER DIAMETER-LIMIT PULPWOOD CUTTINGS. Northeast. Forest Expt. Sta., Sta. Paper 68. 18 pp., illus.

A follow-up study of growth, made 10 years after an experimental diameter-limit cutting, indicated that cutting to a 5-inch diameter limit is too drastic, and not to the advantage of either landowner or woodcutter. Cutting to 8- and 11-inch diameter limits resulted in more rapid recovery of the stand.

*Hutnik, Russell J.

1954. EFFECT OF SEEDBED CONDITION ON PAPER BIRCH REPRODUCTION. Jour. Forestry 52: 493-495.

Why does paper birch become established in some areas but not in others? Effects of leaf litter, fire, and --on abandoned farmland--competing grasses were studied. Though no sure way of getting paper birch reproduction is known, conditions favorable for seedling establishment can be created by removing all the overstory and exposing the mineral soil.

Jensen, V. S.

1953. RECOVERY OF BIRCH AFTER PARTIAL CUTTING. Canada. Dept. Agr. Rpt. Symposium on Birch Dieback: 156-158. (Ottawa.)

A small-scale experimental partial cut of paper and yellow birch was made in New Hampshire in 1931. After 20 years, the cutting was found to have had no effect on net growth rate of paper birch. Growth rate of yellow birch was improved by the treatment. Mortality was about the same as in untreated stands. Post-logging decadence was observed among dominant and codominant trees, but many seem to have recovered completely.

1954. FOREST MANAGEMENT. In Forest Research in New England. Northeast. Wood Util. Council Bul. 42: 32-33.

A canvass made of non-experimental and demonstration forests and other intensively handled forest properties in the Northeast revealed that there is a general lack of information that would serve as guides for preparing various types of forest-management working plans. Also reports on a review of past studies of methods of cutting.

Li, Hui-Lin, and Wright, Jonathan W.

1954. THE CHINESE TULIPTREE (LIRIODENDRON CHINENSE) IN NORTHEASTERN UNITED STATES. Univ. Pa. Morris Arboretum Bul. 5 (3): 34-35.

Chinese tuliptree grown from seed suffered repeated dieback and heavy mortality when tested in Philadelphia, Pa., Beltsville, Md., and Williamstown, Mass. There seems little hope for utilizing this species in the northeastern United States. (Seed was from Lushan Botanical Garden collection.)

*Little, S., and Mohr, J. J.

1954. REPRODUCING PINE STANDS ON THE EASTERN SHORE OF MARYLAND, USING A SEED-TREE CUTTING AND PREPARING SEEDBEDS WITH MACHINERY AND SUMMER FIRES. Northeast. Forest Expt. Sta., Sta. Paper 67. 11 pp.

Using seed-tree cuttings and preparing seedbeds with machinery and summer fires, an effort was made to reproduce a pine stand on abandoned farmland. The fires proved effecting for encouraging pine reproduction, but it is apparent that over the whole area less than half of the next stand will be pine.

*---------- and Somes, H. A.

1954. EFFECT OF AMMATE ON UNWANTED GROWTH IN OAK--YELLOW-POPLAR STANDS IN NEW JERSEY. Northeast. Forest Expt. Sta., Forest Res. Note 29. 2 pp.

In a small-scale test, unwanted trees and shrubs (dogwood, sugar maple, red maple, elm, black cherry, black-

haw, ash, and spicebush) were treated. Small trees were felled and ammate crystals were applied to stump. Cups were chopped in large stems. Treatment was effective but costly.

Lockard, Charles R., and Simmons, Fred C.
1954. FOREST UTILIZATION. In Forest Research in New England. Northeast. Wood Util. Council Bul. 42: 50-52.

Describes advances made in logging, including the trend toward greater mechanization. The Northeast is serving as a pilot plant for the rest of the nation in developing methods of logging small timber in scattered stands.

McGuire, John R.
1954. HARDWOOD TIMBER RESOURCES IN THE NORTHEAST AND THEIR AVAILABILITY FOR PULPWOOD. Paper Trade Jour. 138 (42): 44, 46, 48.

The forest survey shows about 250 million cords of hardwood timber in New England and New York. About 3 million cords a year are cut, of which a fifth goes into pulp. The outlook: supply will increase at least as fast as demand.

*McIntire, S. H.
1954. THE MACHINING OF BEECH.
Northeast. Forest Expt. Sta. and Northeast. Tech. Com. Util. Beech, Beech Util. Ser. 7. 13 pp., illus.

Compares the machining qualities of beech with those of comparable dense hardwoods. In planing, turning, shaping, boring, mortising, sanding, and freedom from splitting, beech can be worked satisfactorily with the same methods and machines that are used for birch and maple.

*McLintock, Thomas F.
1954. FACTORS AFFECTING WIND DAMAGE IN SELECTIVELY CUT STANDS OF SPRUCE AND FIR IN MAINE AND NORTHERN NEW HAMPSHIRE. Northeast. Forest Expt. Sta., Sta. Paper 70. 17 pp., illus.

Fear of wind damage need not be a bar to selective cutting in spruce-fir stands. In experimental cuttings, losses averaged 1.4 percent of the volume per year. Losses increased when more than 20 percent of basal area was cut. Fir was nearly three times as vulnerable as spruce. Very tall trees of both species were very vulnerable.

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1954. THE PENOBSCOT EXPERIMENTAL FOREST.
Northeast. Forest Expt. Sta. 26 pp., illus.

Illustrated booklet describing the Penobscot Experimental Forest near Bangor, Maine, and the research work now under way there. The forest is unique in that it was set up by a group of private wood-using industries that purchased a tract of forest land and leased it to the Federal Government for research purposes.

*Marquis, Ralph W., Weitzman, Sidney, and Holcomb, Carl J.
1954. CUTTING MOUNTAIN HARDWOOD STANDS.
Northeast. Forest Expt. Sta., Sta. Paper 73. 19 pp., illus.

Four experimental cutting treatments were tested on 5-acre plots to compare biologic and economic results of different forest-management methods. Regeneration, growth, volume, and stand quality were analyzed 5 years after cutting. Costs and returns are given, and some general guides for making conditioning cuts are offered to forest owners.

*Northeastern Forest Experiment Station.
1954. ANNUAL REPORT 1953.
Northeast. Forest Expt. Sta. 85 pp., illus.

A summary of the Station's work in 1953, prefaced with a review of significant trends in forestry and forest research. This report describes the subregional areas that are served by the Station's research centers, and the work under way at each center. List of publications.

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1954. THE FOREST RESOURCES OF NEW HAMPSHIRE.
U. S. Dept. Agr. Forest Resource Rpt. 8. 39 pp., illus.

New Hampshire, with 84 percent of its land area in forest, depends heavily on its forest resource for its economic welfare. The pattern of private ownership and small holdings creates special problems in management. Stocking of the forests is only fair; small trees predominate, and there is a large volume of hardwood cull. Net growth exceeds cut, but most of the gain is in small hardwood trees; softwood sawtimber is being cut faster than it grows.

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1954. FOREST STATISTICS FOR THE EASTERN SHORE OF MARYLAND.
Northeast. Forest Expt. Sta., Forest Statis. Ser.: Md. 3. 17 pp., illus.

Forest-survey findings for Caroline, Cecil, Dorchester, Kent, Queen Annes, Somerset, Wicomico, and Worcester Counties: forest area, forest types, timber volume, and condition of the forests. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 2. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 4. 19 pp.

Forest-survey findings for Broome, Chenango, and Madison Counties in south-central New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

*Northeastern Forest Experiment Station.

1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 4. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 5. 19 pp.

Forest-survey findings for Allegany, Livingston, Monroe, Ontario, Schuyler, Seneca, Steuben, Wayne, and Yates Counties in western New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 5. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 6. 19 pp.

Forest-survey findings for Cattaraugus, Chautauqua, Erie, Genesee, Niagara, Orleans, and Wyoming Counties in western New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 6. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 7. 19 pp.

Forest-survey findings for Jefferson, Lewis, and Oswego Counties in north-central New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 8. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 8. 19 pp.

Forest-survey findings for Herkimer, Montgomery, and Oneida Counties in central New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 9. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 9. 19 pp.

Forest-survey findings for Clinton, Essex, and Franklin Counties in northeastern New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

*Northeastern Forest Experiment Station.

1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 10. Northeast Forest Expt. Sta., Forest Statis. Ser.: N.Y. 10. 19 pp.

Forest-survey findings for Fulton and Hamilton Counties in central New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 11. Northeast Forest Expt. Sta., Forest Statis. Ser.: N.Y. 11. 19 pp.

Forest-survey findings for Saratoga, Warren, and Washington Counties in east-central New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 12. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 12. 19 pp.

Forest-survey findings for Albany, Columbia, Greene, Rensselaer, and Schenectady Counties: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 13. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 13. 19 pp.

Forest-survey findings for Orange, Rockland, Sullivan, and Ulster Counties: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 14. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 14. 19 pp.

Forest-survey findings for Dutchess, Putnam, and Westchester Counties: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 15. Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 15. 19 pp.

Forest-survey findings for Nassau and Suffolk Counties, which make up most of Long Island: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation.

*Northeastern Forest Experiment Station.
1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 1. (REVISED.) Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 16. 19 pp.

Forest-survey findings for Delaware, Otsego, and Schoharie Counties: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation. This report supersedes an earlier preliminary report.

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1954. FOREST STATISTICS FOR NEW YORK FOREST DISTRICT NO. 7. (REVISED.) Northeast. Forest Expt. Sta., Forest Statis. Ser.: N.Y. 17. 17 pp.

Forest-survey findings for St. Lawrence County, the largest county in New York: forest area, ownership, forest types, and timber volume. Tabular data and brief explanation. This report supersedes an earlier preliminary report.

Olson, W. Z., and Blomquist, R. J.
1954. GLUING TECHNIQUES FOR BEECH.
Adhesives & Resins 2: 141-144. (London.)

Discussion of glues and gluing techniques for use with beech. Based on Northeast. Forest Expt. Sta. and Northeast. Tech. Com. Util. Beech, Beech Util. Ser. 5, 1953.

*Ostrander, M. D.
1954. LOG GRADING IMPROVEMENTS.
Jour. Forest Prod. Res. Soc. 4: 171-176, illus.

As the amount of low-grade timber has increased, the U.S. Forest Service has intensified research to develop standard log grades as a measure of timber quality. These techniques for measuring quality are rapidly reaching a par with methods of measuring volume. Basic principles of quality appraisal are described.

Schramm, J. R., and Schreiner, Ernst J.
1954. THE MICHAUX QUERCETUM.
Univ. Pa. Morris Arboretum Bul. 5 (4): 54-57, illus.

Describes establishment of a quercetum at the Morris Arboretum in Philadelphia, as a tribute to Francois Andre Michaux, French botanist and early student of American trees, notably oaks. Plans for research in breeding, taxonomy, progeny tests, and tests of exotic species are outlined.

Schreiner, Ernst J.
1954. FOREST TREE IMPROVEMENT WORK IN THE NORTHEAST.
Jour. Forestry 52: 689-691.

Traces tree-improvement work from Colonial times (early botanists made Philadelphia a center of introduction fully 200 years ago) to the present, reviewing racial tests

and individual tree selection, breeding and inheritance studies, and the present boom in forest tree improvement as evidenced in organization (1953) of the Northeastern Forest Tree Improvement Conference.

Schreiner, Ernst J.

1954. A BRIEF NOTE ON THE DESIGN OF POPLAR EXPERIMENTS. United Nations Food and Agr. Organ. 6 pp., illus.

A well-designed poplar experiment requires integration of biological and statistical knowledge. Outlines basic elements of a few simple but statistically sound experimental designs. Clonal tests and spacing in plantations are discussed.

1954. POSSIBILITIES OF INBREEDING, SELECTIVE INTRASPECIFIC BREEDING, RACIAL AND SPECIES HYBRIDIZATION, AND POLYPLOIDY. Northeast. Forest Tree Improve. Conf. Proc. 1: 64-68, illus.

A survey of the various approaches to improving forest trees through breeding and hybridization. There is no one best method for improving all forest species. For some species all the approaches may be useful, for others only one approach may work.

1954. NEED AND OPPORTUNITY FOR COOPERATION ON BREEDING. Northeast. Forest Tree Improve. Conf. Proc. 1: 94-95.

Brief appeal for cooperation by all agencies and individuals concerned with tree improvement. Proposes permanent committee to foster cooperation.

*Simmons, Fred C.

1954. POWER CHAIN SAWS. III. FELLING AND BUCKING. Northeast. Logger 2 (6): 6-7, 25, illus.

Detailed instructions on felling and bucking trees with a chain saw. Importance of bucking to recover the maximum yield of high-grade logs is emphasized. A list of safety precautions for the saw operator is offered.

1954. POWER CHAIN SAWS. SELECTION AND MAINTENANCE. Northeast. Loggers Assoc. 15 pp., illus. Old Forge, N. Y.

Practical advice on selecting a chain saw and maintaining it. Sharpening of teeth is described in detail. Pointers are given on use of the chain saw in felling and bucking, and safety rules are offered. Specifications and prices are listed for some 20 makes of saws.

Simmons, Fred C.

1954. THE QUESTION CORNER. REPLIES.
Northeast. Logger 2 (5): 10-11, illus.
Northeast. Logger 2 (6): 17, illus.
Northeast. Logger 2 (7): 11.
Northeast. Logger 2 (9): 22-23, illus.
Northeast. Logger 2 (10): 12.
Northeast. Logger 2 (11): 14, illus.
Northeast. Logger 3 (2): 16, illus.
Northeast. Logger 3 (3): 23.
Northeast. Logger 3 (4): 12.
Northeast. Logger 3 (5): 10-11, illus.
Northeast. Logger 3 (6): 24-25, illus.

Answers to loggers' and sawmill operators' questions about equipment and methods. Much interest was shown in wheel tractors, use of mill residues for charcoal, and new types of automatic sawmills, including sash gang mills.

1954. RESEARCH IN THE UTILIZATION OF SMALL HARDWOODS.
N. Y. Forester 11 (1): 11-15. (N. Y. Sect., Soc. Amer. Foresters.)

The Northeast has a large--and increasing--resource of small and low-grade hardwoods, more of which should be cut in the interest of good forest management and good economics. The author reviews research being done in logging, pulp manufacture, sawbolt conversion, use for veneer, fuelwood, posts and poles, and other uses to make more of the small hardwood timber marketable.

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1954. STATUS OF RESEARCH IN UTILIZATION OF SMALL HARDWOODS. Jour. Forest Prod. Res. Soc. 4: 384-387, illus.
See above.

1954. HARDWOOD PULPWOOD PROCUREMENT IN THE NORTHEAST.
Paper Trade Jour. 138 (42): 49-52.

Wood procurement is no obstacle to greatly increased use of hardwood for pulp. One can get almost any reasonable quantity of rough hardwood pulpwood delivered to a mill for about $15 a cord, including a stumpage cost of about 50 cents. Mechanization, methods of purchase, and integrated logging operations are discussed.

1954. RELATING SAWMILL "WASTE" TO LOG QUALITY.
Mech. Engin. 76: 327-330, illus.

Some "waste" is unavoidable in sawing logs into boards and lumber--especially small and low-grade logs. Many

uses are being found for the leftover material. The author relates the amount of waste to log size (the smaller the log the more waste), size of lumber sawed, log quality, and sawmill practices.

Simmons, Fred C.

1954. WHEELED TRACTORS IN LOGGING.
Univ. Maine, Maine Forester 1954: 48-65, illus.

Use of wheel tractors has increased greatly. Ordinary farm tractors can now be equipped with winches, sulkies, hydraulic-lift drawbars, and crawler tracks. New machines, specially designed for logging, have been developed. These include 4-wheel-drive tractors in many sizes. It now seems that wheel tractors will take over more and more of the skidding jobs.

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1954. WHEEL TRACTORS IN NORTHEASTERN LOGGING.
Northeast. Logger 2 (11): 16-17, 24-25, illus.
See above.

1954. WHEEL TRACTOR SKIDDING IN THE NORTHEAST.
South. Lumberman 189 (2369): 236-246, illus.

In the last 2 or 3 years there has been a swing to the use of wheel tractors in the Northeast, not only for small jobs but for some of the biggest and roughest logging chances. This is due partly to development of big 4-wheel-drive tractors.

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1954. LOGGING BEECH AND SPECIFICATIONS FOR BEECH PRODUCTS.
Northeast. Forest Expt. Sta. and Northeast. Tech. Com. Util. Beech, Beech Util. Ser. 10. 30 pp., illus.

Beech is logged the same as other hardwoods. Bucking is the critical operation: the logger who knows quality specifications can raise the value of his trees by as much as 50 percent by bucking for highest quality logs. There are sometimes problems in felling rotten-butt trees, and precautions are needed to prevent deterioration. Information on markets and specifications.

Snow, Albert G., Jr.

1954. SELECTION AND BREEDING OF SUPERIOR TREES.
Va. Forests 9 (2): 6-8, 14-15, illus.

One approach to growing better trees in Virginia is by selecting superior individuals or stands as seed sources. Another is by breeding hybrid trees. The author describes some of the problems and some of the results of efforts to

develop better trees by selection and breeding for certain desirable qualities.

Snow, Albert G., Jr.
1954. PROGRESS IN DEVELOPMENT OF EFFICIENT TURPENTINING METHODS. Southeast. Forest Expt. Sta., Sta. Paper 32. 35 pp., illus.

Various modifications of potentially practical methods of turpentining, using bark chipping and acid treatment, were studied in Florida. Results are given for the past 5 years, and relative merits of each method are discussed.

*Somes, H. A., and Moorhead, G. R.
1954. DO THINNING AND PRESCRIBED BURNING AFFECT THE GROWTH OF SHORTLEAF PINE? Northeast. Forest Expt. Sta., Forest Res. Note 34. 2 pp.

In a small study of old-field shortleaf pine in New Jersey, a low thinning was found to have little effect on growth. But prescribed burning did favor both net growth of all pines and growth of the largest pines (future crop trees).

Storey, Herbert C.
1954. WATER PROBLEMS AND WATERSHED MANAGEMENT. Pa. Forests 44: 60-62, 70-73, illus.

General discussion of water problems in the Northeast, and the potentialities of watershed management. A fund of information about water behavior and soil relationships, and effects of logging on the water resource, is being acquired through research. Studies now under way touch only the more pressing problems; much more research is needed.

*(---------- McQuilkin, W. E., and McNamara, Eugene.)
1954. REPORT NO. 2. FOREST AND WATER RESEARCH PROJECT. DELAWARE-LEHIGH EXPERIMENTAL FOREST. Pa. Dept. Forests and Waters. 48 pp., illus. Harrisburg.

Progress report on studies on the Delaware-Lehigh Experimental Forest in Pennsylvania, including watershed studies and conversion of scrub oak land to productive forest. Describes detailed studies of soil and vegetation on a gaged watershed, and water relationships determined. Detailed hydrologic and climatic data.

Trimble, G. R., Jr.
1954. FORESTS ARE IMPORTANT ON THE WATERSHED. W. Va. Conserv. 18 (1): 3-7, illus.

Tells how management of forested watershed lands can help to conserve and regulate the water supply. Recommends logging methods and equipment that protect watershed

values. Based on watershed studies at Fernow Experimental Forest in West Virginia.

*Trimble, G. R., Jr., and Weitzman, Sidney.
1954. EFFECT OF A HARDWOOD FOREST CANOPY ON RAINFALL INTENSITIES. Amer. Geophys. Union Trans. 35: 226-234, illus.

Ground rainfall intensities and throughfall were measured under a fully stocked hardwood stand in West Virginia for 1 year. The study showed that low rain intensities are reduced more by summer canopy, and high intensities are reduced more by winter canopy. Throughfall is reduced by canopy interception about the same in both winter and summer.

*Waterman, Alma M.
(1954) SEPTORIA CANKER OF POPLARS IN THE UNITED STATES. U.S. Dept. Agr. Cir. 947. 24 pp., illus.

Describes canker caused by the fungus Septoria musiva, a destructive disease of hybrid poplars: history, symptoms, hosts and distribtuion, and causal organism. Tests of susceptibility were made on 202 selected hybrid poplar clones; results are given. None of the clones tested can be considered immune. Control methods are suggested.

---------- and Aldrich, K. F.
1954. ADDITIONAL INFORMATION ON THE SURFACE STERILIZATION OF POPLAR CUTTINGS. U. S. Dept. Agr. Plant Dis. Rptr. 38 (2): 96-100.

A number of fungicides were tried for sterilizing cuttings to prevent transmittal of fungus diseases. Of those tried, Semesan (30% hydroxymercurichlorophenol) and Ceresan M (7.7% ethyl mercury p-toluene sulfananilide) proved most effective. Greenhouse tests showed they were not toxic to the cuttings.

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1954. SURFACE STERILIZATION OF HYBRID POPLAR CUTTINGS. Northeast. Forest Expt. Sta., Forest Res. Note 32. 3 pp.

A number of fungicides were tried for sterilizing hybrid poplar cuttings to prevent spread of fungi diseases by cuttings shipped out for planting. Only three--mercuric chloride, Ceresan M, and Semesan--proved effective. Greenhouse tests showed that mercuric chloride tended to retard growth; so Ceresan M or Semesan might be preferable.

*Waters, W. E., and McIntyre, T.
1954. FOREST INSECT CONDITIONS IN THE NORTHEAST--1953. Northeast. Forest Expt. Sta., Sta. Paper 72. 17 pp.

Describes severity of infestations by major forest insects, plans for future surveys, and control plans. Dis-

cussion of spruce budworm, forest tent caterpillar, gypsy moth, white pine weevil, Matsucoccus scale, beech scale, and balsam woolly aphid. Tabulation of other insect pests of forest and shade trees.

Weitzman, Sidney.
1954. WHY WE NEED WATERSHED RESEARCH IN WEST VIRGINIA. W. Va. Conserv. 17 (12): 4-7, illus.

In West Virginia, demands for water supply are increasing, and shortages threaten. Stream fluctuations, sedimentation, heavy pollution, and floods indicate a growing problem. Some ills could be remedied by engineering works, but research is needed to find practical answers for the complex problem.

*Westveld, Marinus.
1954. A BUDWORM VIGOR-RESISTANCE CLASSIFICATION FOR SPRUCE AND BALSAM FIR. Jour. Forestry 52: 11-24, illus.

One defense against the spruce budworm is through silviculture that will make stands more resistant. From studies of susceptibility and vulnerability and growth-vigor relationships, the author developed a tree-classification system for selecting individual trees according to their ability to resist attack. The criteria used are maturity, dominance, and crown (length, width, density). Use of the tree-classification system is described, including application to cutting methods for different stand conditions.

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1954. USE OF PLANT INDICATORS AS AN INDEX TO SITE QUALITY. Northeast. Forest Expt. Sta., Sta. Paper 69. 5 pp.

Outlines the indicator-plant concept, and describes the development of an indicator-plant classification as a guide to site quality in the forests of the Northeast. Vegetation types provide the index to timber yield potentials and a sound basis for orientation of silvicultural goals.

*Wilson, Robert W., Jr., and Jensen, Victor S.
1954. REGENERATION AFTER CLEAR-CUTTING SECOND-GROWTH NORTHERN HARDWOODS. Northeast. Forest Expt. Sta., Forest Res. Note 27. 3 pp.

A small area in the Bartlett Experimental Forest in New Hampshire was poorly stocked 10 years after clear-cutting despite good seed sources. The timber species could not compete with the rank growth of blackberries and raspberries that came in.

Wright, Jonathan W.

1954. RACIAL VARIATION AND INDIVIDUAL TREE SELECTION IN THE NORTHEAST. Northeast. Forest Tree Improve. Conf. Proc. 1: 20-25.

Describes possibilities of genetic improvement by selecting individual trees and stands for racial variation.

1954. INTERSPECIFIC HYBRIDIZATION IN SPRUCE, MAPLE, AND ASH AT THE NORTHEASTERN FOREST EXPERIMENT STATION. Northeast. Forest Tree Improve. Conf. Proc. 1: 77-81.

Report on hybridization work done. Successful crosses reported in all three genera. In spruce, geographic range of the species provides the best clue to crossability.

1954. PRELIMINARY REPORT ON A STUDY OF RACES IN BLACK WALNUT. Jour. Forestry 52: 673-675.

A test of seed from three broad climate zones (Northwest, Central, and Southern United States) indicates three kinds of variation: geographic races that must be taken into account in procuring seed for forest planting; local races and individual variations that can be utilized to improve timber or nut production.